

## DRAFT ENVIRONMENTAL IMPACT REPORT



# LONG-RANGE WASTEWATER MANAGEMENT PLAN

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**LONG-RANGE  
WASTEWATER MANAGEMENT PLAN FOR THE  
SANTA ROSA REGION**

**DRAFT ENVIRONMENTAL IMPACT REPORT**

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City of Santa Rosa

DECEMBER, 1986



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**LONG-RANGE WASTEWATER MANAGEMENT PLAN  
FOR THE SANTA ROSA REGION  
ENVIRONMENTAL IMPACT REPORT  
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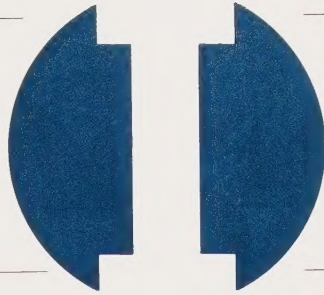
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# INTRODUCTION



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## 1 INTRODUCTION

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### 1.1 WASTEWATER MANAGEMENT SYSTEM IMPROVEMENTS

The City of Santa Rosa operates a subregional wastewater treatment and disposal system that serves the Cities of Santa Rosa, Sebastopol, Rohnert Park, Cotati and the South Park County Sanitation District. Sewage is collected from the service area and conveyed to three treatment plants. Treated effluent from the three plants is disposed of by discharge to the Laguna de Santa Rosa, a tributary of the Russian River, and by irrigation of approximately 4,000 acres of pasture. If weather conditions are favorable the existing treatment and disposal system performs satisfactorily. If weather conditions are unfavorable, the system's ability to dispose of wastewater is exceeded, and treated effluent must be released to the Laguna de Santa Rosa, a tributary of the Russian River, in amounts that may violate state and federal permit requirements.<sup>1</sup>

In May, 1985, the City of Santa Rosa engaged an engineering consulting firm, CH2M-Hill with the instruction that they should prepare a long-range wastewater management plan that would make the regional system's operations independent of the weather. Shortly thereafter, the City engaged EIP Associates, an environmental planning firm, to provide an independent evaluation of the plan and to prepare an environmental impact report (EIR).

Development of the long-range wastewater management plan has proceeded in two phases. In the first phase of the planning studies, a broad range of alternatives, including several suggested by the public, were evaluated by the City's engineering and environmental consultants.<sup>2</sup> The most-promising alternatives were identified for more detailed analysis in the second phase.<sup>3</sup> This report describes the environmental consequences of implementing each of the promising alternatives.

## 1.2 THE ENVIRONMENTAL REVIEW PROCESS

The California Environmental Quality Act (CEQA) requires that an environmental impact report be prepared that fully describes the environmental effects of a proposed project, before a decision is made to proceed. The EIR is a public document that a government agency uses to analyze the environmental effects of a proposed project, to identify alternatives and to explore ways to reduce or avoid environmental damage

CEQA requires that the lead agency, in this case the City of Santa Rosa, shall neither approve nor carry out a project as proposed, unless the significant environmental effects have been reduced to an acceptable level. An acceptable level is defined as "eliminating, avoiding or substantially lessening" the significant effects. If the lead agency approves the project, even though significant impacts cannot be mitigated, the agency must state in writing the reasons for its action. This statement, referred to as a Statement of Overriding Considerations must be included in the record of project approval.<sup>4</sup>

In October, 1985, a notice was sent to interested government agencies, organizations and individuals informing them that the City of Santa Rosa intended to prepare an EIR on its long-range wastewater management plan and requesting that they identify any issues they felt should be addressed in the EIR. On 26 November, 1985, a meeting was held with the staff of a number of government agencies to discuss and clarify their concerns. On 3 December, 1985, a similar meeting was held with members of the public. Early in 1986 two further public meetings were held to discuss the preliminary results of the planning studies.

This Draft EIR is now available for public review. Written comments on the draft must be received by 15 February, 1987. A public hearing will be held in February, 1987. Responses to all comments will be prepared and included in the Final EIR. The Board of Public Utilities and the City Council will then review the Final EIR, and decide which alternative wastewater management system is in the best interests of the community.

## 1.3 ORGANIZATION OF THE EIR

The wastewater management system alternatives being considered could affect a broad geographical area and many different aspects of the environment. A comprehensive

evaluation of the alternatives is necessarily lengthy. The EIR has been organized to be useful to both the technical reviewer who needs to consider the impacts in detail and the more general reader who wants to understand the main consequences of implementing the alternatives, but does not have time to read the entire report.

Following this introduction is a summary of the environmental effects of each wastewater management system alternative and a listing of suggested mitigation measures. The summary is designed to provide the general reader with the relevant information on which decision-making will be based. More detailed information is provided in the subsequent chapters.

Chapter 3 outlines the history of wastewater management in the Santa Rosa area and describes why the system improvements are needed. The four most promising alternative wastewater management systems are described in Chapter 4. Chapter 5 is a description of the general environmental setting or background against which the effects of the alternatives can be judged.

The direct effects of the alternatives on various aspects of the environment are described in Chapters 6 through 17. Each chapter is organized in three sections; first, a description of the environmental setting, second an assessment of the environmental impacts of operation of each alternative and third, an assessment of the environmental impacts of construction of each alternative. The environmental impacts of system operation would be long-term effects that would continue for the life of the system. The environmental impacts of system construction would only be felt for a relatively short period of time.

Chapter 18 is a discussion of the relationship between the wastewater management system alternatives and growth in the Santa Rosa region. Chapter 19 addresses several matters of environmental philosophy, as required by CEQA.

A separate discussion of some improvements to the wastewater solids handling system that are needed immediately, regardless of which wastewater management system is implemented, is contained in Chapter 20.

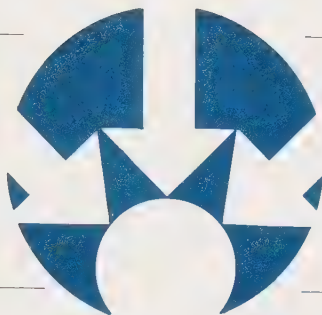
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<sup>1</sup> All wastewater discharges to the navigable waters are regulated in accordance with the provisions of the federal Clean Water Act. All discharges must receive a permit as a part of the National Pollutant Discharge Elimination System (NPDES). In California, the NPDES is administered by the State Water Resources Control Board.

<sup>2</sup> The possibility exists that other communities such as Windsor or Healdsburg might connect to the regional system. If this possibility were to be evaluated in detail, it would be the subject of a separate EIR.

<sup>3</sup> Two reports were prepared documenting the analyses conducted in the first phase of the studies. They are "Long-Term Study of Treatment and Disposal Alternatives, Phase 1, Preliminary Analysis of Alternatives", CH2M-Hill, April, 1986 and "Environmental Evaluation, Long-Range Wastewater Management Alternatives", EIP Associates, March, 1986.

<sup>4</sup> California Environmental Quality Act, Statutes and Guidelines, California State Office of Planning and Research, 1986.



## SUMMARY & FINDINGS



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## 2 SUMMARY & FINDINGS

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### 2.1 WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES

The Santa Rosa region's wastewater management problem could be solved in a number of different ways. During the first phase of the long-range planning study, a large number of alternative solutions were identified and evaluated by the City's engineering and environmental planning consultants. Alternatives suggested by the public were also evaluated. At the end of the first phase of the study, CH2M-Hill, the engineering consultant, recommended that the five most promising alternatives be studied, in more detail, the second phase. One of the five was eliminated early in the second phase. The remaining alternatives are:<sup>1</sup>

- o Alternative 1 -- Reuse at the Geysers
- o Alternative 2 -- Indirect disposal to the Russian River
- o Alternative 3 -- Disposal to the Pacific Ocean
- o Alternative 4 -- Disposal to the San Pablo Bay.

All four alternatives would involved expanding the City of Santa Rosa's Laguna wastewater treatment plant to provide capacity for an average dry weather flow of 25 mgd, a flow rate that is expected to be reached in 2010. In the case of Alternative 2, indirect Russian River disposal, the treatment level that wastewater would receive would be upgraded substantially. Secondary treatment would be provided as part of the other three alternatives. All four of the alternatives would retain the existing wastewater irrigation system which would continue to be used to dispose of between 15% and 25% of the treated effluent. The alternatives are shown in Figure 2-1.

Alternative 1 involves pumping treated wastewater north-eastward through an approximately 40-mile long pipeline to the Geysers geothermal area where it would be used by the steamfield operators.

Alternative 2 involves pumping treated wastewater north through an approximately 17-mile long pipeline to a rapid infiltration system adjacent to the Russian River west of the community of Windsor. Effluent entering the rapid infiltration system would percolate into the ground before emerging as seepage to the Russian River.

Alternative 3 involves pumping treated wastewater west through a 22-36 mile long pipeline to the Pacific Ocean. Effluent would enter the ocean through a long submarine outfall extending into deep water.

Alternative 4 involves pumping treated wastewater south through an approximately 38-mile long pipeline to San Pablo Bay. Effluent would be discharged to the Bay through a long submarine outfall terminating in deep water. Some or all of the effluent would be used to create a freshwater marsh before discharge to the bay.

## **2.2 CRITICAL ISSUES**

Reaction to the City of Santa Rosa's emergency discharge of treated effluent to the Russian River, in February, 1985, was strongly critical, particularly among the residents of downstream communities. Concern about the effects of wastewater discharge on river water quality and the health of drinking water consumers remains high. Similar concerns have been expressed about wastewater discharge to the Pacific Ocean and San Pablo Bay and its potential effects on water quality and aquatic life.

Increasing the capacity of the wastewater system will allow the region to grow, a matter of great concern to a segment of the community. In addition, changes to the existing wastewater irrigation system could result in conversion of agricultural lands to urban uses or more intense agricultural use.

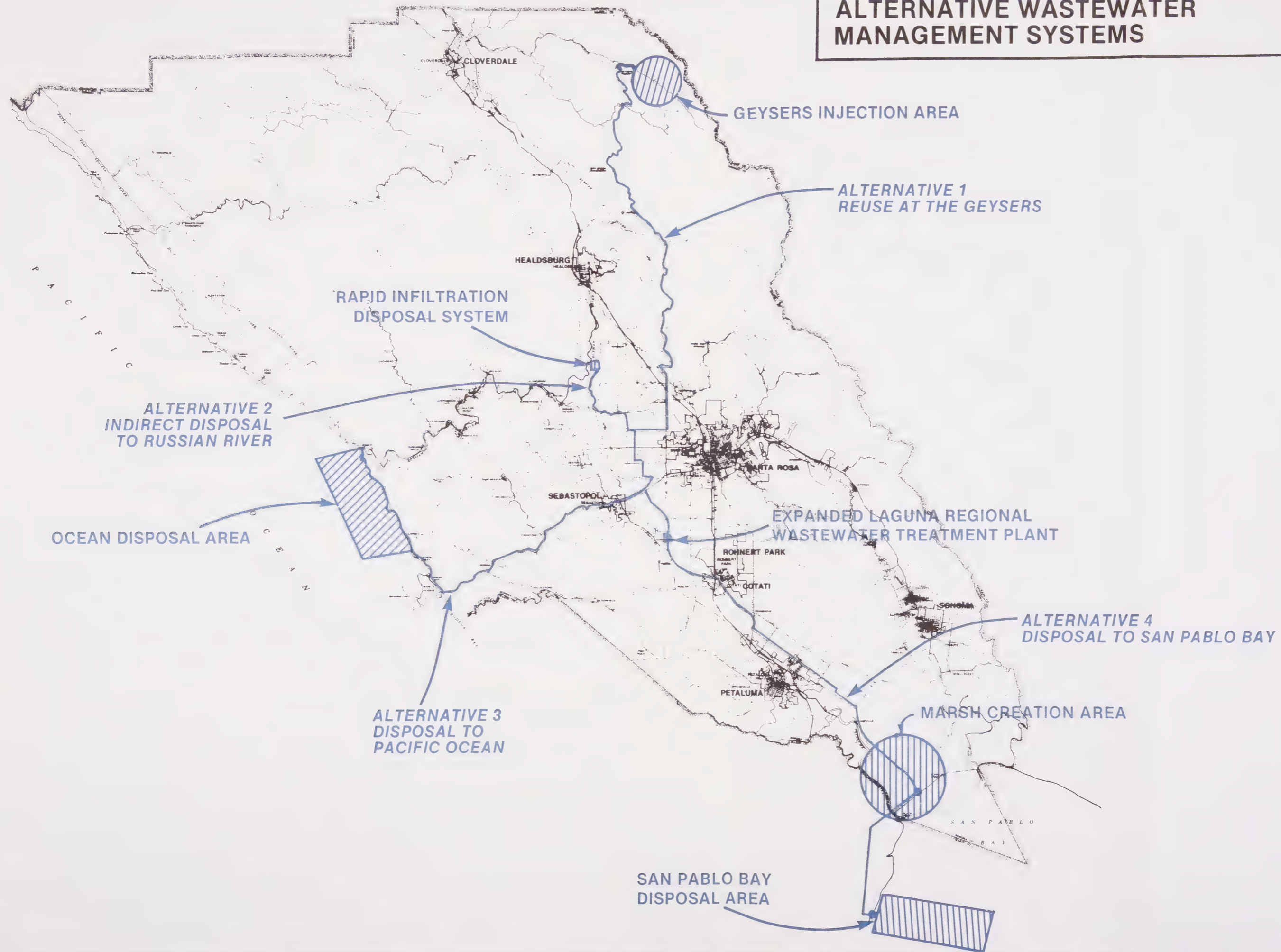
The impacts of construction, although short-term, are of concern to some.

## **2.3 ENVIRONMENTAL EVALUATION OF ALTERNATIVES**

Wastewater is potable water to which certain substances have been added as a result of human use. Some of these substances are harmful to human beings and the environment. It is because of these harmful substances that the water is considered to be sewage or

# ALTERNATIVE WASTEWATER MANAGEMENT SYSTEMS

FIGURE 2-1





wastewater. Most, but not all, the harmful substances or pollutants can be removed by treatment. With the exception of bacteria which are destroyed in the treatment process, most of the pollutants are simply removed from the water and retained at the treatment plant as sludge.

Both Federal and State governments require that wastewaters be disposed of in a manner that does not harm the environment or public health. All dischargers of wastewater must meet certain stringent requirements. One of the requirements is that any discharge must receive, at least, secondary treatment. Secondary treatment removes all the floating and settleable material and about 90% of the other pollutants. Effluent from a secondary treatment plant is a clear, earthy smelling, but inoffensive liquid, containing low concentrations of organic suspended matter and bacteria. Higher levels of treatment can produce water of higher quality.

The following paragraphs compare different aspects of the alternatives. First, and probably most important, is the environmental evaluation of treatment/disposal modes. Other factors that could influence the choice of alternatives are then discussed; the consequences of system failure, growth accommodation or inducement and construction impacts.

### 2.3.1 TREATMENT/DISPOSAL MODES

Of interest in evaluating disposal modes is the ultimate fate of any pollutants that remain in the water after treatment. What are their probable environmental effects? Because stringent discharge requirements must be met in all cases, none of the treatment/disposal modes could have gross adverse effects on the environment or public health. There could, however, be more subtle differences between the alternatives.

Reuse at the Geysers would probably have the least environmental impact of the treatment/disposal modes considered. Treated wastewater would be injected deep into the ground and converted to steam. Contaminants in the treated wastewater would be decomposed by heat or retained in deep rock formations. Water from the deep formations is not used for drinking purposes because it contains high concentrations of ammonia, boron and other chemicals, so the possibility of human consumption is negligible and any other form of human contact unlikely. Reuse at the Geysers has two other advantages;

first it serves a useful purpose, rather than being simply a disposal method, and second it avoids the adverse environmental effects that might occur when the geothermal operators develop a new water source. Some believe, however, that use of wastewater for injection would prolong the life of the geothermal area and thus extend the period during which the adverse environmental impacts of geothermal development would be felt.

Unlike reuse at the geysers, the other treatment/disposal modes rely on dispersion in the environment of any pollutants remaining after treatment. Of this group, ocean disposal is probably the most effective and consequently has the least potential for harm. The vastness of the ocean ensures that any remaining pollutants would be rapidly diluted and dispersed widely. There is no scientific evidence that discharge of secondary treated municipal wastewater is harmful to the ocean and aquatic life. It is worth noting, however, that some object to ocean disposal on principle, perhaps because the ocean has been much abused in the past. These feelings may be heightened in this case, because the coast between San Francisco and the Oregon border is free of major municipal wastewater discharges.

The other two treatment/disposal modes involve a slightly greater risk of environmental harm, although still within a range deemed acceptable by the regulatory agencies. Indirect disposal to the Russian River year-round involves some possibility of human ingestion of wastewater constituents because the river is used as a water supply source. The actual risk to health however, is very slight, perhaps less than it is today. At present, Santa Rosa discharges about 3 billion gallons of secondary treated wastewater to the river annually. The river discharge alternative would employ a level of treatment higher than secondary that would reduce the pollutant level in the effluent by a factor of 10 or more. Thus, although the total volume of treated effluent discharged to the river annually might increase to 9 billion gallons by the year 2010, the mass of pollutants discharged would decrease by at least a factor of three.

At present, all of the Santa Rosa region's treated wastewater is discharged to the Russian River during high flow periods when dilution in the river is at its greatest. Because Alternative 2 involves year-round disposal to the river, discharge would continue even when river flow is low and dilution at its least. Theoretically the possibility of wastewater constituents entering downstream water supply intakes could be increased. In

reality, it is almost inconceivable that wastewater constituents could remain at harmful levels after advanced treatment, passage through the soil and dilution in the river. Some may object to the concept of this type of reuse, even though there is no specific evidence that harm could occur.

Discharge to San Pablo Bay, whether through a long outfall or through a man-made freshwater marsh, would add to the already large volume of treated municipal and industrial wastewater that is discharged to the San Francisco Bay system. Although the condition of the Bay has improved greatly, in some respects, over the last 30 years, a number of environmental problems remain. Examples are the decline of the Dungeness crab and striped bass, and the elevated levels of toxic materials found in the tissues of some shellfish and marine mammals. Although the cause of these problems remains unknown, it is possible that discharge of municipal wastewater may be a contributing factor. For this reason, it appears that a discharge to the Bay involves a greater risk of adverse environmental change than a discharge to the ocean, where the dilution available is much greater.

### 2.3.2 CONSEQUENCES OF MALFUNCTION OR ACCIDENT

It was noted earlier that because of the need to meet the stringent requirements of the regulatory agencies, no alternative system, operating as intended, would have gross adverse effects on the environment. It is also important to examine the environmental consequences of a malfunction or accident. What are the possible modes of failure, their likelihood and environmental consequences?

Wastewater treatment systems, however skillfully operated, are prone to occasional upsets, usually resulting from a variation in the quality of the incoming sewage. The more technologically complex the process employed, the more vulnerable the system is to upset. Without the provision of special facilities to handle upsets, the various receiving environments could be subject to discharge of inadequately treated sewage for short periods of time. While this would probably not represent a serious difficulty for a deepwater discharge to the ocean or San Pablo Bay, it could have serious consequences for a river discharge. To avoid the possibility of adverse environmental effects during a treatment plant malfunction, some of the existing ponds could be designated for emergency storage of effluent, not meeting discharge standards. Unlike most

comparably-sized wastewater treatment and disposal systems, the Santa Rosa system has the capacity to store 14 to 41 days of flow in its existing ponds. As a result the Santa Rosa system is relatively resistant to adverse impacts during a treatment process malfunction.

All the alternatives, despite being built in accordance with California's standards for earthquake resistance, would be vulnerable to damage in a major seismic event. The pipeline to the Geysers crosses several small, but active faults. If the pipeline ruptured during an earthquake, treated wastewater would have to be discharged to the Russian River, once the capacity of the City's emergency storage ponds was reached.

The deepwater outfall in the Pacific Ocean would have to cross the San Andreas fault several thousand feet from shore. Rupture of the outfall during an earthquake might result in an ocean discharge at a lesser depth and distance from shore than is intended. It is unlikely that any environmental damage would result provided treatment levels could be maintained. If the treatment system failed simultaneously, and pond storage is not available, it may be necessary to quarantine shellfishing until the treatment system was repaired.

### 2.3.3 POTENTIAL FOR GROWTH-INDUCEMENT

A project creates potential for growth-inducement when construction or improvement of infrastructure provides capacity for land development and population increases that exceed the planned growth of an area. The proposed Santa Rosa regional wastewater treatment and disposal system would have the potential to induce growth if it accommodated significantly more development than allowed by the current General Plans of the cities served by the system. In that case, development might occur taking advantage of the excess capacity, despite community goals to the contrary. Any development would be subject to governmental review and approval, however.

The project alternatives are sized to accommodate projected wastewater flow in 2010. Flow estimates were made based on population and employment projections made by the Association of Bay Area Governments (ABAG) for 2005. The projections were extended to 2010 assuming that the projected growth rate between 2000 and 2005 continues to 2010. The planning staffs of the cities served by the wastewater system agree that the ABAG

projections accurately reflect trends in their areas. The ABAG projections also agree closely with projections made by Sonoma County as part of its General Plan update. Based on the above, it appears that the alternative projects are sized to accommodate planned growth. They would not serve as an inducement to growth beyond that planned.

It is apparent, however, that the lack of sewage treatment and disposal capacity can act as a constraint to growth as evidenced by the connection moratorium imposed by the Regional Water Quality Control Board in 1985. Implementation of any of the wastewater management alternatives would remove this constraint to growth.

#### 2.3.4 CONSTRUCTION IMPACTS

Components of the alternative systems include treatment units, pump stations, pipelines and submarine outfalls. Construction of the pipelines would have the greatest potential impact on the environment. Pipeline construction would last about four weeks at any particular location and would create noise, dust and traffic congestion. Although impacts would vary from alternative to alternative, they all could be mitigated to an acceptable level and so construction impacts should not strongly influence the choice of an alternative wastewater management system.

Pipelines would be located almost exclusively within existing roadways. Approximate pipeline lengths from the Laguna Treatment Plant to the disposal site, not including submarine outfalls are:

o	Geysers	39 miles
o	Russian River	17 miles
o	Pacific Ocean	22 - 36 miles
o	San Pablo Bay	38 miles

Some routes would be more difficult and disruptive than others. Pipelines to the Geysers and to the rapid infiltration system would follow lightly trafficked rural roads through sparsely populated areas. The pipelines to the Pacific Ocean and San Pablo Bay follow State highways and pass through Sebastopol, Guerneville and Cotati. One of the pipeline routes to the ocean, the northern route via Guerneville would affect narrow, winding,

redwood-lined sections of Highway 116. The last section of the pipeline to San Pablo Bay, after it leaves Highway 37, involves a difficult crossing of wetlands.

### 2.3.5 SIGNIFICANT ADVERSE EFFECTS THAT CANNOT BE AVOIDED

The California Environmental Quality Act requires that significant adverse environmental effects that cannot be avoided must be identified in an EIR on a proposed project. Section 15002(g) of the State's guidelines for implementing the California Environmental Quality Act states that "A significant effect on the environment is defined as a substantial adverse change in the physical conditions which exist in the area affected by the proposed project."

Based on this definition, none of the wastewater management alternatives would have a significant adverse effect on the environment. All four alternatives would have to comply with stringent state and federal regulations promulgated to protect water quality, public health and aquatic life.

Although there is no scientific evidence to suggest that discharge of secondary-treated wastewater to the ocean through a long submarine outfall would be harmful to the marine environment, some may feel that the introduction of such a discharge to an area currently free of direct wastewater discharge, is in itself a significant impact. In the same way, some may feel that disposal of highly treated wastewater to a river that serves as a source of drinking water supply is a significant impact even if there is no evidence that the practice adversely affects public health.

## 2.4 COSTS

The estimated monetary costs of the alternate wastewater management systems are shown in Table 2-1. The table shows capital costs, operation and maintenance costs and present worth costs. Capital costs are the sum of the costs of land acquisition and construction, engineering and legal services and all other costs incurred prior to start-up of the new system. Operation and maintenance costs are the sum of the annual costs for labor, energy, spare parts and repairs needed to keep the system running.

TABLE 2-1  
COST OF WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES<sup>a</sup>

<u>Alternative</u>		<u>Capital Cost</u> (\$ million)	<u>Operation &amp; Maintenance Cost</u> (\$ million/yr)	<u>Revenue</u> (\$ million/yr)	<u>Total Present Worth</u> (\$ million)
1	Reuse at Geysers	92	17	Unknown	275 <sup>b</sup>
2	Indirect Disposal to Russian River	72	7	0	142
3	Disposal to Pacific Ocean	97	7	0	160
4	Disposal to San Pablo Bay	127	7	0	196

<sup>a</sup>Costs expressed in 1990 dollars.

<sup>b</sup>Does not include revenue from sale of water to the geothermal operators.

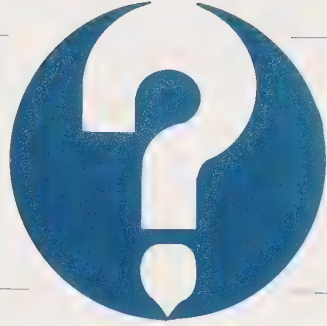
The most useful estimate, when comparing alternatives is the total present worth. The total present worth is a measure of the total cost of construction, operation and maintenance and equipment replacement over a twenty-year period. Based on present worth, Alternative 2, indirect disposal to the Russian River is the least costly. Alternative 3, ocean disposal is 14% more expensive than the least cost alternative. However, because cost estimates made during preliminary engineering are only of limited accuracy these two alternatives could be regarded as equally costly. The estimated cost of the remaining alternatives, Alternatives 1 and 4, are 37% and 93% greater than the least cost alternative.

The true cost of Alternative 1, reuse at the Geysers cannot be estimated because it is not known what the geothermal operators would be willing to pay for the treated wastewater. The City would have to receive \$400 or \$500 per acre-foot of water delivered to the Geysers to make this alternative comparable in cost to ocean or river disposal.

To finance construction of the alternative wastewater management systems, connection fees for residential customers would have to increase to between \$2,500 and \$5,000 and monthly service fees to between \$22 and \$35.

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<sup>1</sup>The alternatives have been renumbered for the convenience of the reader. In the first phase reports, Alternatives 1 through 4 were designated Alternatives 1b.2, 2a.4, 3b and 4a.2 respectively.



# NEED FOR THE PROJECT



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### **3 THE NEED FOR WASTEWATER SYSTEM IMPROVEMENTS**

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#### **3.1 INTRODUCTION**

Improvements to the Santa Rosa regional sewer system are needed for two reasons. The first and most important reason is that effectiveness of the existing wastewater management system depends on the weather. If weather conditions are favorable, the existing system performs satisfactorily. If weather conditions are unfavorable, then treated wastewater must be released to the Russian River in violation of state and federal regulations.

The second reason for the project is to be able to accommodate increased sewage flows in the future. The existing plant can treat an average daily dry weather flow of 15 million gallons per day (mgd). The present average daily dry weather flow is about 14 mgd. The corresponding projected flows in 1990 and 2010 are 17 and 25 mgd respectively.

#### **3.2 THE EXISTING SYSTEM, ITS HISTORY AND PROBLEMS**

The Santa Rosa regional wastewater treatment and disposal system serves the Cities of Santa Rosa, Sebastopol, Rohnert Park, Cotati and the South Park County Sanitation District. The locations of these communities within Sonoma County are shown in Figure 3-1. Sewage is collected from the service area and conveyed to three treatment plants, the Laguna plant, the Oakmont plant and the West College plant. The West College plant is operated only during wet weather to reduce the load on the Laguna plant and during the dry season to provide small amounts of irrigation water. Treated effluent from the two plants is disposed of by discharge to the Laguna de Santa Rosa, a tributary of the Russian River, and by irrigating pasture. The disposal system includes about 4,000 acres of irrigated land and a number of storage ponds with a capacity of 1.5 billion gallons.

The existing wastewater system has gradually evolved as the population of the Santa Rosa Plain has grown and environmental regulations have become more stringent. In the 1960s and early 1970s, several engineering studies were conducted to determine the best way to

treat and dispose of wastewater from the various communities in the area. In 1973, a plan was approved. The plan called for the consolidation of treatment at the two Santa Rosa plants, with effluent disposal by pasture irrigation and river discharge. The Laguna plant would be expanded and the level of treatment it could provide would be increased.

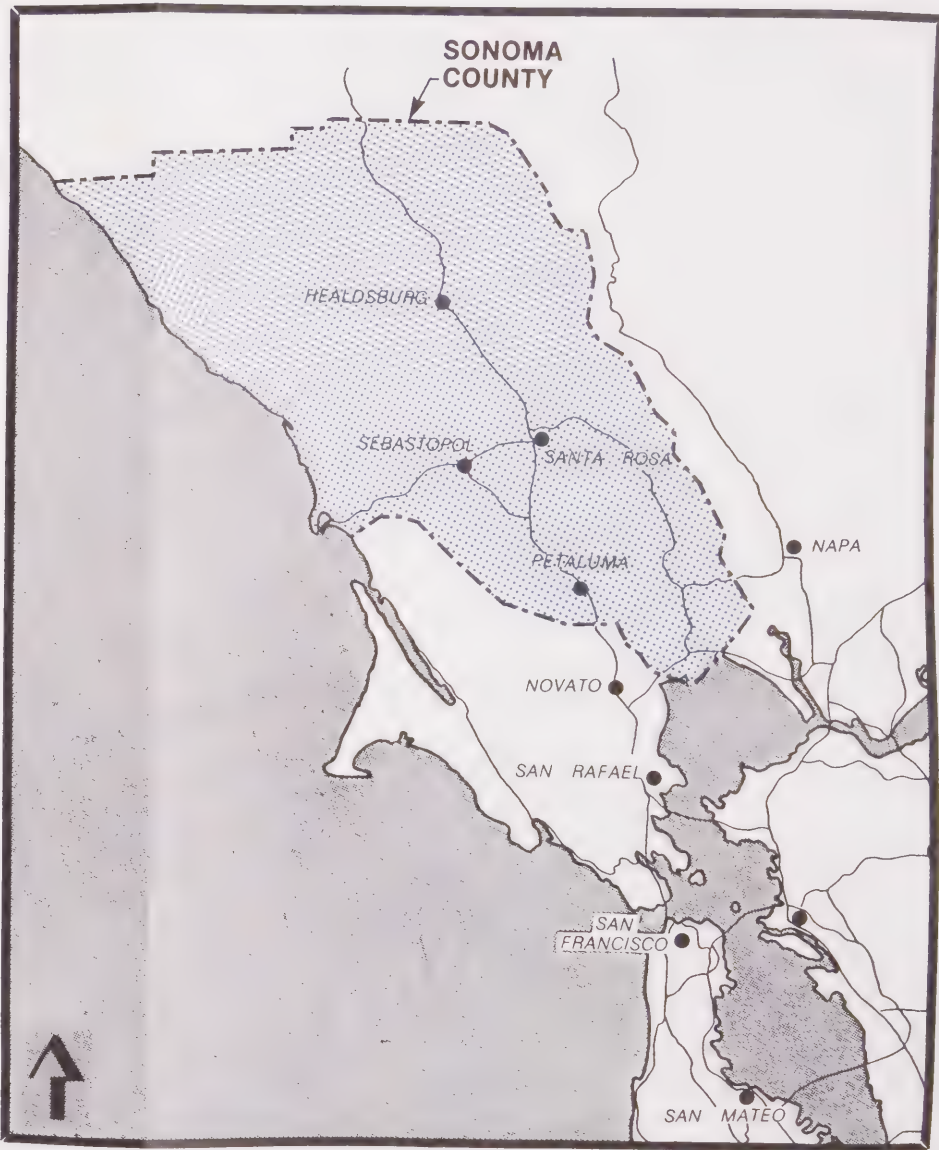
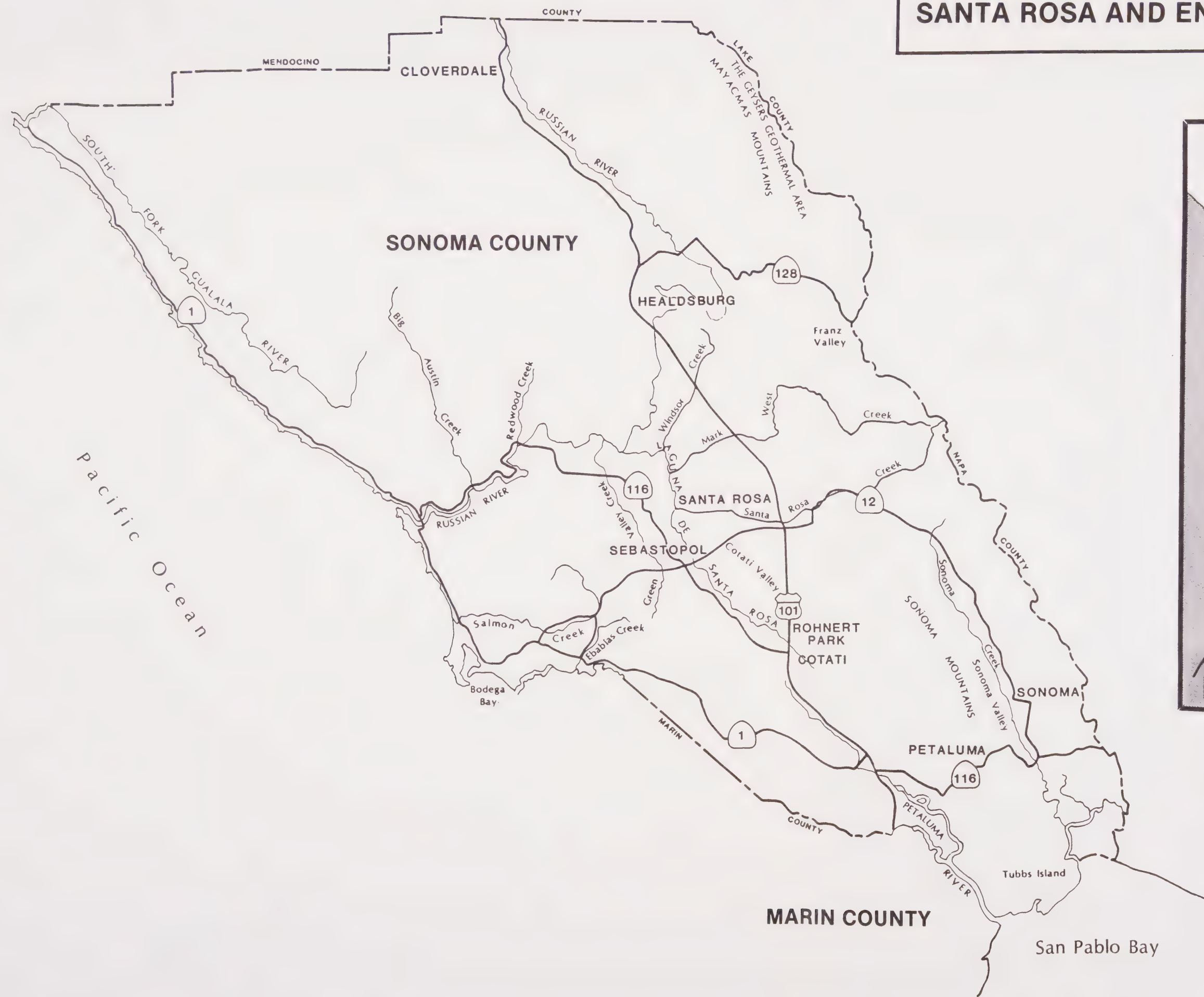
The plan was developed, in part, to meet the effluent discharge requirements imposed on the City of Santa Rosa by the Regional Water Quality Control Board, North Coast Region, the agency responsible for water pollution control in the area. The Regional Board prohibited discharge to the Russian River during the summer months. Accordingly, the plan had to provide an alternative method of disposal for the treated effluent when river discharge was not permitted. The method chosen was pasture irrigation. The City's consulting engineers believed, however, that if the level of treatment at the Laguna Plant was increased from secondary to something better, the Regional Board would allow some summertime discharge of highly treated effluent to the river. With such a summertime discharge, the need for storage ponds and irrigation areas could kept within reasonable limits.

The City began to implement the plan in the mid-1970s. Extensive studies were undertaken to prove the feasibility of pasture irrigation with treated wastewater and to develop design criteria for the irrigation system. Both the Laguna treatment plant and the irrigation system were expanded. A higher level of treatment was not added, however, because it had become uncertain whether the Regional Board would allow a summertime discharge to the river, regardless of how well treated the effluent might be. In addition, the Board imposed a further requirement limiting wintertime discharge to no more than 1% of Russian River flow and that no discharge would be permitted when river flow was less than 1,000 cubic feet per second.

Faced with these circumstances, the City began a program to expand the capacity of its storage ponds and to increase the area of pasture available for wastewater disposal. The effect of the Regional Board's requirements, however, was to make the City's ability to dispose of its treated wastewater dependent on the weather. While the weather remained close to normal, the combination of pasture irrigation during the summer and river discharge during the winter was sufficient to dispose of the City's treated wastewater. When the weather was unfavorable, problems arose.

SANTA ROSA AND ENVIRONS

FIGURE 3-1





Early in 1985, a crisis occurred. After a drier than average winter in 1983-84, during which less treated wastewater could be discharged to the river than was usual, the City entered the winter of 1984-85 with a large volume of wastewater in storage. Weather in the first few months of the winter followed an uncharacteristic pattern. Heavy rain in October and November saturated the soil so that it was impossible to irrigate during these months and for some time thereafter. Little or no rain in December and January caused river flow to decline, making it impermissible to discharge to the river. The amount of treated wastewater in storage began to approach the capacity of the ponds and it became apparent that, without drastic action, an uncontrolled discharge was inevitable.

Rather than risk the consequences of an uncontrolled discharge, the City made a controlled emergency discharge for several days in February, 1985. The discharge was made in accordance with the terms of a waiver issued by the Regional Board and served to lower the water level in the City's ponds. It was agreed that it was better to release the treated wastewater early in the year, rather than risk an uncontrolled release later, when recreational use of the Russian River is at its peak.

Reaction to the incident was strongly critical, particularly among the residents of the downstream Russian River communities. The Regional Board imposed a moratorium on sewer hook-ups to the Santa Rosa regional collection system until such time as plans were prepared to avert a reoccurrence.

Recognizing that its wastewater management strategy had failed, the City of Santa Rosa engaged a new engineering consultant, CH2M-Hill. CH2M-Hill was charged with the task of preparing wastewater management plans that would avoid future problems. Short- and intermediate-term management plans were prepared that would prevent another emergency discharge in the next few winters. After the initial elements of the short-term plan were presented to the Regional Board, the Board lifted the moratorium on sewer hook-ups on condition that the City proceed expeditiously to prepare a long-term wastewater management plan that will provide an environmentally-sound solution to the region's wastewater disposal problem that is independent of the weather.

### 3.3 FUTURE NEEDS

Although development of the long-term wastewater management plan is, primarily, a response to the present disposal problems, it must also take account of future needs. The Santa Rosa region is growing rapidly and any new or expanded facilities would be designed to accommodate projected future flows. The following paragraphs describe the basis for the projections of future wastewater flow.

#### 3.3.1 DESIGN PERIOD

The first step in the planning process was to determine the design period. The design period extends from today, until the time at which the new facilities would reach capacity and would need to be expanded again. The choice of a design period is a matter of judgment. If the design period is too short, then the facilities may need to be expanded within a few years of their original construction -- usually an inefficient and expensive process. If the design period is too long, then public funds are committed to the provision of infra-structure capacity that will remain unused for many years.<sup>1</sup>

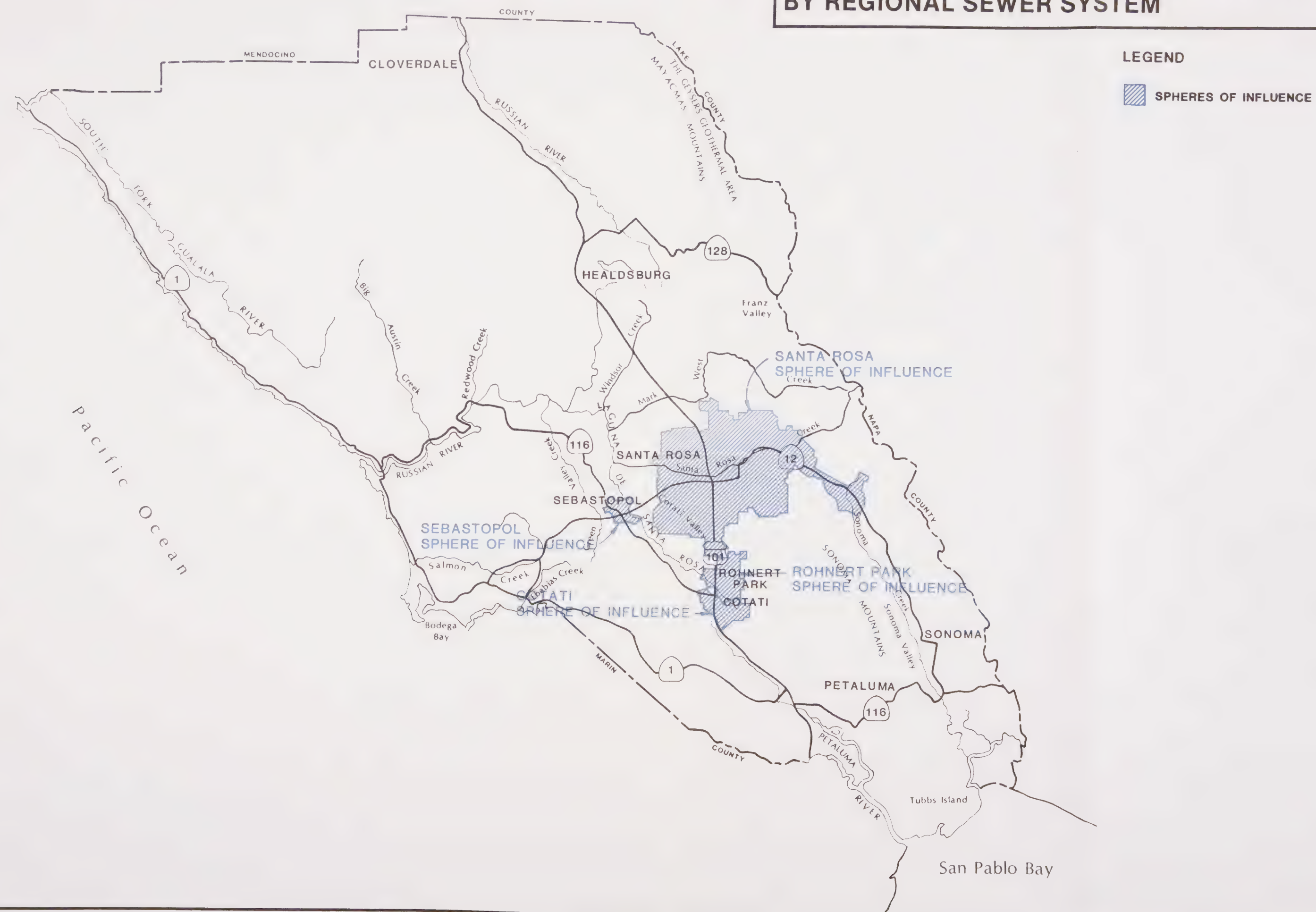
The selected design period for the long-range wastewater management plan is 24 years -- from today until the year 2010. This period was chosen because it is expected that the new facilities will not come into operation until about 1993 and it would be desirable that they provide 15 or 20 years of service before they might need to be expanded again. Consequently, the new facilities would be sized to accommodate the wastewater flow projected for the year 2010. This design period is consistent with the Regional Board's wishes with respect to development of a long-term plan.

#### 3.3.2 POPULATION AND ECONOMIC PROJECTIONS

In order to be able to estimate future wastewater flows, projections of future population and employment in the service area were made. The service area was taken to be the spheres of influence of the cities of Cotati, Rohnert Park, Sebastopol and Santa Rosa and is shown in Figure 3-2.<sup>2</sup> The projections are based on earlier studies by the Association of Bay Area Governments and the Sonoma County Planning Department, the General Plans for Sonoma County and the cities of Santa Rosa, Rohnert Park, Cotati and Sebastopol and discussions with the planning staffs of these agencies.<sup>3</sup>

SPHERES OF INFLUENCE OF CITIES SERVED  
BY REGIONAL SEWER SYSTEM

FIGURE 3-2





It is projected that the population of the service area will grow from 162,050 in 1985 to 249,000 in 2010, an increase of about 54% or roughly 2% each year. Employment is expected to grow from approximately 83,000 in 1985 to 138,000 in 2010, an increase of about 66%. A detailed breakdown of the projections by community is shown in Table 3-1. These projections are consistent with the existing general plans and planning policies of the County and the tributary cities.

#### 3.3.3 WASTEWATER FLOW PROJECTIONS

Projections of future wastewater flow were made by multiplying the population and employment estimates by wastewater generation rate factors derived from the City of Santa Rosa's present flow records. A typical Santa Rosa resident produces 73 gallons of wastewater each day at his home. Typical employees of commercial establishments, retail stores or restaurants, for example, produce 47 gallons of wastewater each day at their place of business. The wastewater generation rates of industrial employees varies widely. The per employee wastewater generation rates for employees of "new technology" industries, "existing technology" industries and light industry are 69, 52 and 7 gallons per day, respectively.

Average dry weather flow to the Laguna treatment plant is expected to increase from the present 14 mgd to 25 mgd by the year 2010.

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<sup>1</sup>In recent years, several Northern California sewage agencies have selected short design periods for their new facilities and, as a consequence, find themselves in a more or less continuous expansion program. The sewage agency in the Monterey Peninsula, for example, is already preparing expansion plans for its, as yet uncompleted, regional treatment plant.

<sup>2</sup>A sphere of influence is defined as the probable ultimate boundaries and service area of a government agency.

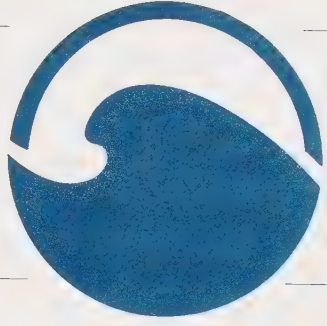
<sup>3</sup>CH2M-Hill's analysis is documented in Technical Memorandum T1, contained in their Phase 1 report. Other references are Projections '85: Forecasts and Projections for the San Francisco Bay Area in the Year 2005, Association of Bay Area Governments, July, 1985, "Sonoma County General Plan Update -- Employment Trends Analysis and Revised Projections", prepared for Sonoma County Planning Department by Angus McDonald and Associates, September, 1985, "Sonoma County General Plan Land Use Element" (Second Preliminary Draft), Sonoma County Planning Department, April 11, 1986, and "Amendment of the Land Use Element of the Sonoma County General Plan," Sonoma County Planning Department, (no date).

TABLE 3-1  
POPULATION AND EMPLOYMENT PROJECTIONS  
1985-2010

	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
Cotati						
Population	4,950	5,600	6,000	6,400	6,800	7,200
Employment <sup>1</sup>	N/A	N/A	N/A	N/A	N/A	N/A
Rohnert Park						
Population	28,900	30,400	33,400	38,800	45,000	52,200
Employment <sup>1</sup>	11,100	13,200	14,900	16,600	18,200	20,000
Santa Rosa						
Population	120,400	144,000	146,000	158,900	168,700	179,100
Employment	65,100	73,700	81,700	89,700	98,600	108,400
Sebastopol						
Population	7,800	8,600	9,200	9,700	10,100	10,500
Employment	7,000	7,400	7,800	8,200	9,100	10,000
Total Study Area						
Population	162,050	177,600	194,600	213,800	230,600	249,000
Employment	83,200	94,300	104,400	114,500	125,900	138,400

<sup>1</sup>Employment estimates are available for the combined planning areas of Cotati and Rohnert Park and appear in the row for the latter community.

Sources: Association of Bay Area Governments, Projections '85.  
Sonoma County General Plan Land Use Element, Second Preliminary Draft  
(April 1986) and Amendment to the Land Use Element (no date).  
EIP Associates.  
CH2M-Hill.



# ALTERNATIVE WASTEWATER MANAGEMENT SYSTEMS



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## **4 WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES**

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### **4.1 INTRODUCTION**

The Santa Rosa region's wastewater management problem could be solved in a number of different ways. During the first phase of the long-range planning study, a large number of alternative solutions were identified and evaluated by the City's engineering and environmental planning consultants. Alternatives suggested by the public were also evaluated. At the end of Phase 1, CH2M-Hill, the engineering consultant, recommended that the five most promising alternatives be studied, in more detail, in Phase 2.<sup>1</sup> One of the five was eliminated early in Phase 2. The remaining alternatives are:

- o Alternative 1: Reuse at the Geysers
- o Alternative 2: Indirect Disposal to Russian River
- o Alternative 3: Disposal to the Pacific Ocean
- o Alternative 4: Disposal to the San Pablo Bay.

The following paragraphs describes each of the alternatives that were considered in Phase 2 of the studies. They are shown in Figures 4-1. Alternatives considered in Phase 1, but rejected are discussed at the end of the section.

### **4.2 WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES**

#### **4.2.1 ALTERNATIVE 1: REUSE AT THE GEYSERS**

This alternative involves expanding the City of Santa Rosa's Laguna treatment plant to provide capacity for an average daily dry weather flow of 25 mgd. The level of treatment would remain the same as that provided today, that is, secondary treatment. The treatment system expansion would occur within the existing plant boundaries.

Treated effluent would be pumped approximately 35 miles north to the Geysers geothermal area for industrial use. The pipeline would be 42 and 48 inches in diameter and would generally follow highway rights-of-way. Five pumping stations with a combined power of 22,500 hp would be needed as the Geysers geothermal area is about 3,000 feet above Santa Rosa. Pumps would be housed in small concrete block structures about 30 feet square and 20 feet high. The pipeline route is shown in Figure 4-2.

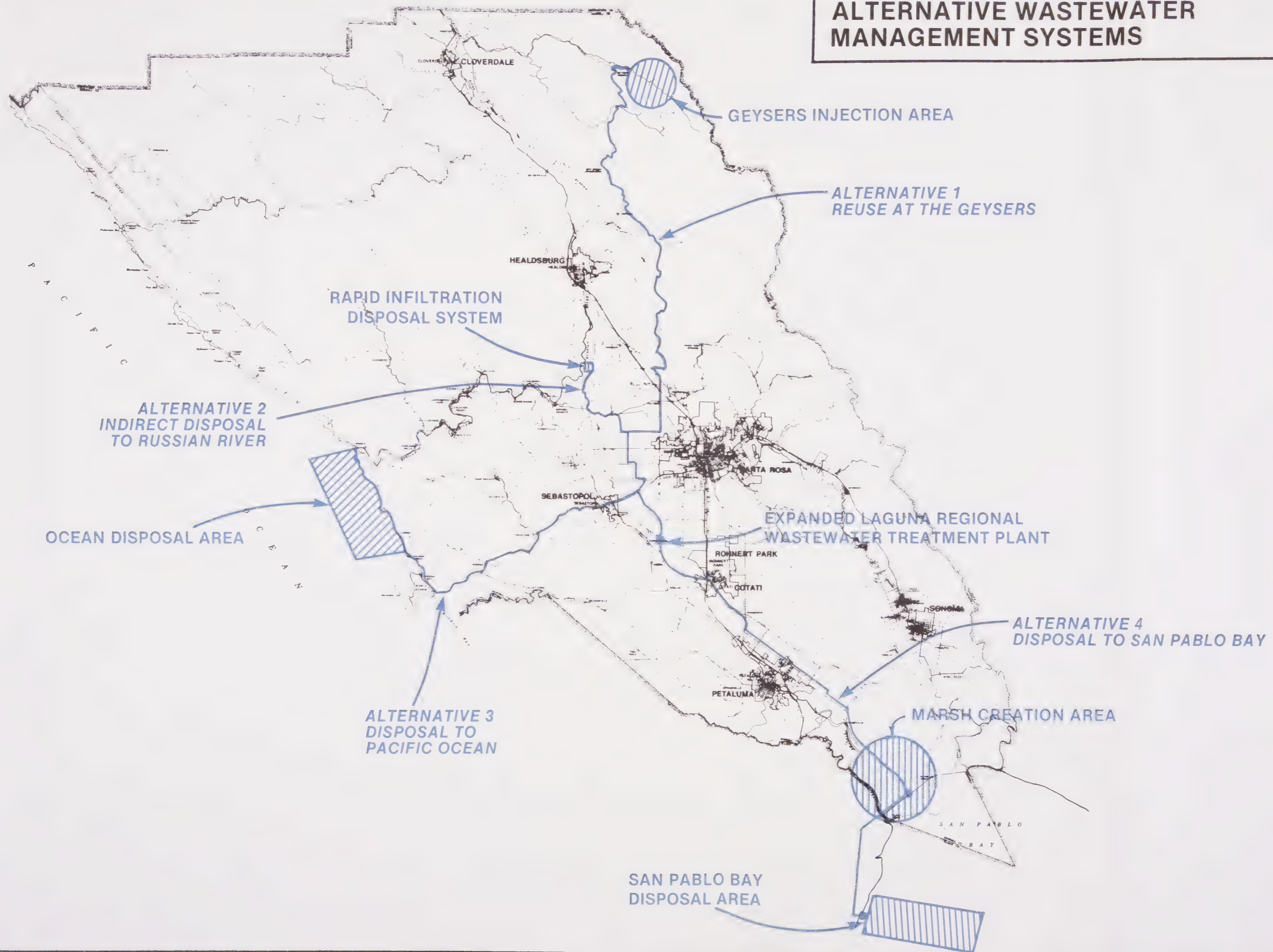
From the treatment plant, the pipeline would follow Llano Road northwards to Highway 12. After paralleling Highway 12 for a few hundred feet, the pipeline would again turn northward on Irwin Lane to the intersection with Occidental Road. At Occidental Road, the pipeline would turn west to the intersection with Piezzi Road where it would again turn north to the intersection with Hall Road. At Hall Road, the pipeline would turn west to the intersection with Willowside Road, where it would resume its northward course. The pipeline would turn east at Piner Road and continue to its intersection with Fulton Road. At Fulton Road, it would again turn north, cross Highway 101, and continue to Old Redwood Highway. After following Old Redwood Highway for about two miles, the pipeline would turn east on Pleasant Avenue and continue to its intersection with Chalk Hill Road. The pipeline would follow Chalk Hill Road for about 5 miles to its intersection with Highway 128. After paralleling Highway 128 for about 3 miles, the pipeline would turn north-east on Alexander Valley Road and enter the Geysers geothermal area via Pine Flat Road or via Red Winery Road and Geysers Road.

At the Geysers, treated effluent would be temporarily stored in ponds and then injected into the geothermal strata. The steamfield operators believe that power production is limited by a lack of water in the steamfield and hence, a lack of steam. If additional water was injected deep into the geothermal strata, then more steam could be withdrawn and used to drive turbines and produce electricity. After leaving the turbines, steam derived from injected wastewater would be condensed in cooling towers and reinjected into the geothermal strata.

During the summer months, a portion of the treated wastewater would be used to supply the City of Santa Rosa's existing wastewater irrigation system as it is today. The existing system consists of about 4,000 acres of irrigated pastureland adjacent to Llano Road. On average, 15%-25% of the treated wastewater can be reused in this way each year. In a dry year, a larger proportion of the treated wastewater would be used for irrigation.

# ALTERNATIVE WASTEWATER MANAGEMENT SYSTEMS

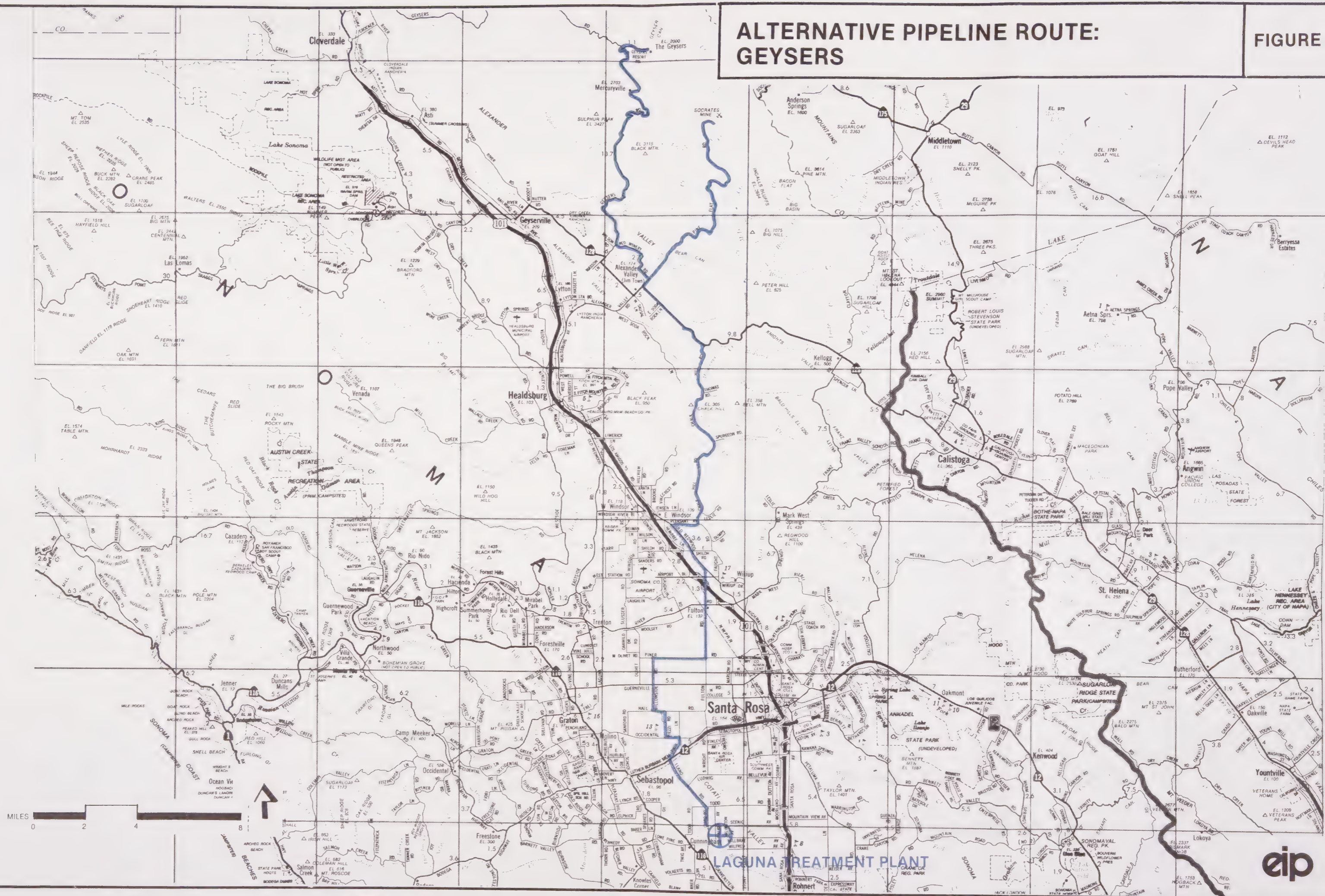
FIGURE 4-1





# ALTERNATIVE PIPELINE ROUTE: GEYSERS

FIGURE 4-2





### 4.2.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

Alternative 2 involves expanding and upgrading the Laguna treatment plant. The plant would be expanded to accommodate an average daily dry weather flow of 25 mgd. The treatment level provided at the plant would be increased from the present secondary treatment to advanced wastewater treatment with nutrient removal. The advanced wastewater treatment system would consist of conventional secondary treatment with biological nutrient removal, and chemically-enhanced sedimentation. Effluent would be discharged to the Russian River, via the existing ponds and a new rapid infiltration system. With the exception of the rapid infiltration system, the new and expanded treatment facilities would all be built within the boundaries of the existing treatment plant.

Treated effluent would be pumped approximately 15 miles north to the rapid infiltration system to the west of the community of Windsor. The pipeline would be 42 and 48 inches in diameter and would generally follow highway rights of way as shown in Figure 4-3. A single pumping station would be required. From the treatment plant to the intersection of Willowside and Piner Roads the pipeline would follow the same route as that described in Alternative 1. At that intersection the pipeline route would turn west on Piner to Olivet where it would turn north again to the intersection with River Road. After following River Road westward about one-quarter mile, the route would turn north on Slusser to its intersection with Station Road. The route would follow Station Road west to Starr Road. Heading north the route would follow Starr Road to near Windsor River Road and hence west to the rapid infiltration system.

Rapid infiltration systems consist of earthen basins constructed in coarse-textured soils that allow treated wastewater to percolate rapidly into the ground. Systems of this type are used by over 300 municipalities in the United States including the nearby Cities of Healdsburg and Cloverdale. There are few suitable sites for a rapid infiltration system near the Laguna treatment plant. A suitable site must have permeable soils, must lie above the water table and be outside the seasonal flood plain of the Laguna de Santa Rosa. A promising site has been identified; it is shown in Figure 4-4. The rapid infiltration system would occupy approximately 120 acres of land.

Because of the hydrogeologic characteristics of the site, treated wastewater applied to the rapid infiltration system would percolate into the groundwater and flow toward the nearest water course, the Russian River. In effect, any treated wastewater

that reached the river course would have travelled through at least 100 feet of soil. Passage through the soil reduces the concentrations of certain substances in the effluent, in effect providing additional treatment before discharge.

During the summer months, a portion of the treated effluent would be used to supply the City's existing pasture irrigation system. An average of between 15% and 25% of the effluent would be disposed of in this way each year.

During extremely high Russian River flows that are sustained for more than one month, it would be necessary to release treated wastewater directly to the river because the rapid infiltration would become ineffective. A release of this sort would be expected once every three years.

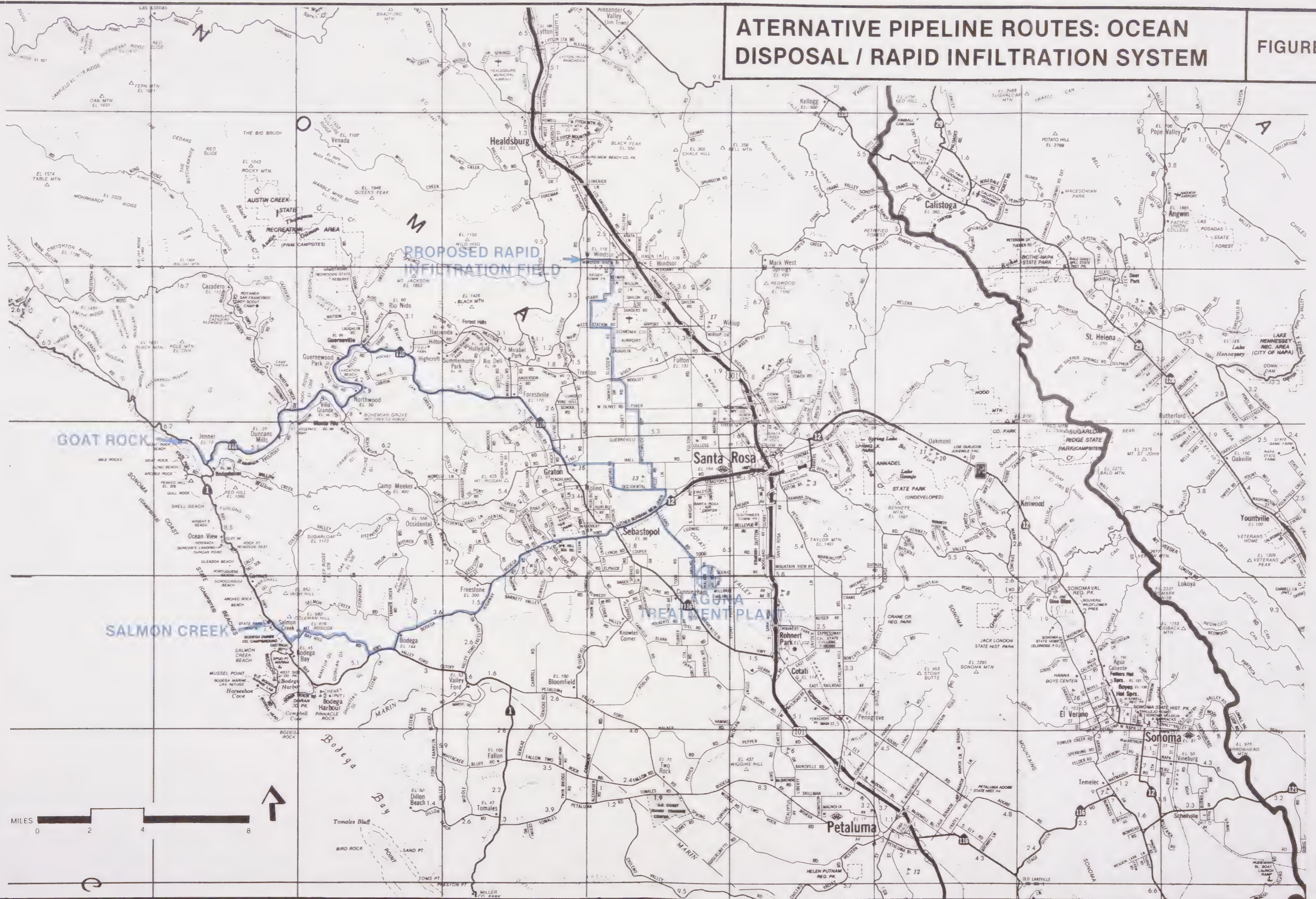
### 4.2.3 ALTERNATIVE 3: DISPOSAL TO THE PACIFIC OCEAN

The Laguna treatment plant would be expanded, within its existing boundaries, to provide secondary treatment to an average daily dry weather flow of 25 mgd. Treated effluent would be conveyed to the coast by pipeline and discharged to the Pacific Ocean, several miles off-shore. Two ocean outfall locations are being considered. Each would employ a different pipeline route. The first option, referred to as the northern route, would terminate in a submarine outfall near the mouth of the Russian River. The second option, known as the southern route, would terminate in a similar outfall near the mouth of Salmon Creek. Both pipelines would be 42 to 48 inches in diameter and would require a single pumping station to operate them. The pumping station would be a small concrete block structure about 30 feet square and 20 feet high. The pipeline routes are shown in Figure 4-3.

A pipeline following the northern route would leave the treatment plant by way of Llano Road and proceed northward to the intersection with Highway 12. After paralleling Highway 12 for a few hundred feet, the pipeline would turn north on Irwin Lane to its intersection with Occidental Road. The pipeline would follow Occidental Road to its intersection with Sanford Road. At Sanford Road, the pipeline would turn north to the intersection with Hall Road. The pipeline would follow the extension of Hall Road across Highway 116 to Hicks Road. At Hicks Road, the pipeline would turn north until the road merges with Highway 116. The pipeline alignment would then follow Highway 116, through Forestville and Guerneville, to the coast near the mouth of the Russian River.

# ALTERNATIVE PIPELINE ROUTES: OCEAN DISPOSAL / RAPID INFILTRATION SYSTEM

FIGURE 4-3





## FIGURE 4-4



The ocean outfall would be located between the river mouth and Goat Rock and would extend 8,500 feet offshore and terminate at a depth of 100 feet.

A pipeline following the southern route would also leave the treatment plant by way of Llano Road and proceed northward to its intersection with Highway 12. The pipeline would follow Highway 12 to Sebastopol and then Bodega Highway to its intersection with Bay Hill Road just beyond the community of Bodega. It would then follow Bay Hill Road to Highway 1 where it would turn north to the mouth of Salmon Creek.

The outfall at Salmon Creek would be 8,500 feet long and would terminate in 100 feet of water.

As in the case of the other alternatives, 15% to 25% of the treated effluent would be supplied to the City's existing pasture irrigation during the summer months.

### 4.2.4 ALTERNATIVE 4: DISPOSAL TO SAN PABLO BAY

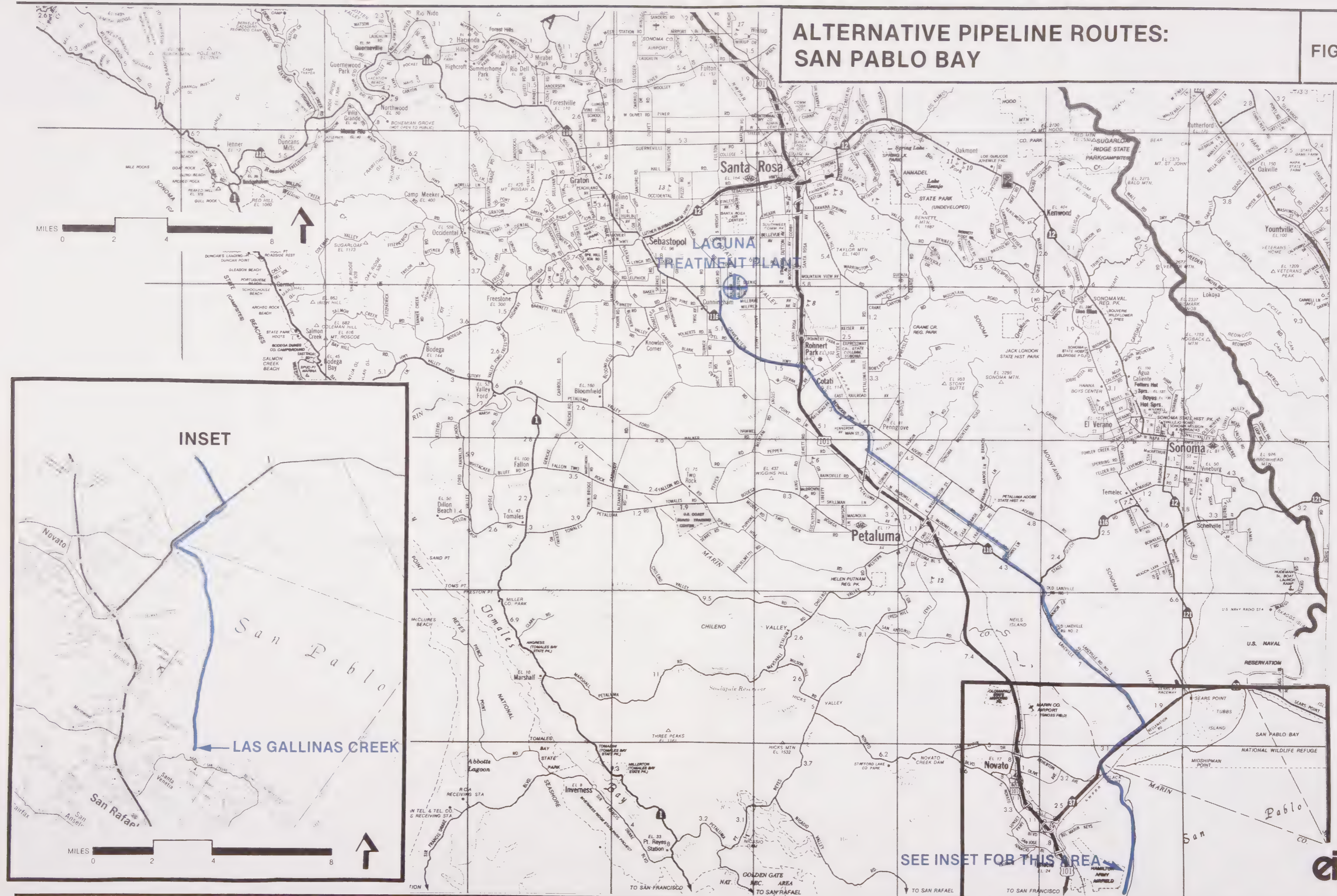
The Laguna treatment plant would be expanded to provide secondary treatment to an average daily dry weather of 25 mgd. The expansion would be accomplished within the existing plant boundaries. Treated effluent would be pumped to the edge of San Pablo Bay through a 39-mile mile long 48 inch diameter pipeline. Two pumping stations would be required. They would consist of a small concrete block structure about 30 feet square and about 20 feet high. The pipeline route is shown in Figure 4-5.

The pipeline would follow Llano Road to the Gravenstein Highway, Highway 116, and follow it south to Cotati. From Cotati it would proceed south on Old Redwood Highway and Ely Road, rejoining Highway 116 near Petaluma. The pipeline would follow Highway 116 to its intersection with Lakeville Road. At Lakeville Road, the pipeline would continue south to Highway 37, where it would turn west to Black Point. From Black Point, the pipeline would follow the edge of San Pablo Bay, across the marshes, to the mouth of Los Gallinas Creek. The outfall would extend from the mouth of the creek to the deep water channel near Point San Pedro. The outfall would be about 22,000 feet long and would terminate in 35 feet of water.

Some or all of the treated effluent would be used to create a freshwater marsh near San Pablo Bay in the area west of Lakeville Road and north of Highway 37. Freshwater marsh is a habitat type that wildlife agencies believe is underrepresented in the Bay Area. The

## ALTERNATIVE PIPELINE ROUTES: SAN PABLO BAY

FIGURE 4-5





marsh would not be designed to act as a treatment unit, although some incidental treatment might occur. Effluent from the marsh would be discharged to the Bay via the deep water outfall. The purpose of the freshwater marsh would be to provide a benefit that would offset the environmental cost of an additional wastewater discharge to San Pablo Bay.

15% to 25% of the treated effluent would be used, during the summer months to supply the City's existing pasture irrigation system.

### 4.2.5 ALTERNATIVES CONSIDERED BUT REJECTED

In Phase 1 of the planning study, CH2M-Hill evaluated a broad range of alternatives, some of which were suggested by the public. The criteria for evaluation of alternatives included technical and regulatory feasibility, reliability, public acceptability, environmental effects and cost. The City of Santa Rosa and its consultants concluded that the alternatives described earlier in this chapter are the most promising. Alternatives considered but rejected are described in general terms below. A more complete discussion can be found in the Phase 1 reports.<sup>1,2</sup>

A number of alternatives were considered that would eliminate the existing wastewater irrigation system. It was concluded that this would be undesirable for several reasons. Without the free or very low cost water, local farmers might have to spend an additional \$1,000,000 annually on purchase of other feed such as alfalfa hay. The increased cost could cause financial hardship for some. In addition, some farmers would probably dispose of excess acreage, no longer needed for forage crops. Altered agricultural practices on the excess lands may be less compatible with the natural resources of the Laguna than the existing irrigated pasture.

Wildlife agency staff believe that the natural resource values of the Laguna de Santa Rosa are preserved, to some extent, by the nature of the neighboring agricultural activities. Without agricultural irrigation in the summer months, the Laguna would probably dry up.

Based on the above, it was apparent that any alternative that did not involve the continued use of the existing wastewater irrigation system would probably have an adverse effect on the local economy and the natural resources of the Laguna de Santa Rosa.

At the other end of the spectrum, an alternative was considered that would expand the wastewater irrigation system to dispose of all of the effluent. A very large storage reservoir would have to be built in Southern Sonoma County, most probably in the Tolay Valley, east of Petaluma, to store treated wastewater during the non-growing season. This alternative was rejected for several reasons. Events of the last few years have shown that the City must have a reliable wastewater disposal system that is independent of weather conditions. A regional wastewater irrigation system would always be dependent on the weather to some degree. More importantly it would necessitate expansion of the system to irrigate about 17,000 acres, more than four times the area irrigated today. Management of the existing system has proved difficult and time consuming. Expansion would make management even more complex, difficult and probably unreliable. Furthermore, a regional irrigation system would be more expensive than any of the recommended alternatives largely because the City would have to construct extensive distribution and irrigation systems. To ensure that the irrigated land would always be available for wastewater disposal, the City would either have to purchase the land or execute long-term contracts with landowners. Because of the present weakness of the agricultural economy, landowners are reluctant to sign long term contracts. Thus, the City would have to own much of the land to be sure that disposal capacity would always be available.

Several alternatives were considered in Phase 1 of the studies that would involve direct discharge of treated wastewater to the Russian River. They were rejected because the Regional Water Quality Control Board will permit only indirect discharges unless a high degree of dilution in the river is available. Alternative 2 was devised to conform with the Regional Board's wishes. The subject of direct and indirect discharges is discussed in Chapter 6.

A number of other alternatives, including recycling and water conservation, were suggested by the public. Reclamation of wastewater for drinking purposes is technically feasible, but undesirable, for other reasons. However sophisticated the treatment system, complete recycling inevitably increases the risk of consumption of substances that are injurious to human health. There is no reason to take such a risk when other options are available.

#### 4. Wastewater Management System Alternatives

Several other reclamation possibilities were suggested. Groundwater recharge with reclaimed wastewater introduces a similar, although lesser, risk of contamination of drinking water supplies, as does complete recycle. Forest irrigation, properly managed would be environmentally benign, although it would probably increase the possibility of human contact with reclaimed wastewater or wastewater aerosols.<sup>3</sup>

Water conservation was suggested as a way of eliminating the need for new sewage facilities. Because Santa Rosa's existing system is dependent on the weather, potentially environmentally-damaging incidents can occur at the present sewage flow rate. As a consequence, treatment and disposal improvements would have to be made even if flows remained the same. There is no doubt, however, that it is advantageous from an environmental point-of-view to keep future flows as small as possible. The City of Santa Rosa already requires new construction to include water conservation measures.

Flow to the wastewater treatment plant, although not pollutant load, could be reduced by the use of "gray water" systems that divert relatively unpolluted household wastewaters to individual irrigation or disposal systems. While potentially useful in rural areas, widespread use of gray water systems in an urban or suburban setting would increase the risk to public health because it is rarely possible to completely separate the polluted and unpolluted waste streams.

Another flow reduction technique is control of infiltration and inflow. Infiltration and inflow into the sewage collection system increase the volume of wastewater that must be treated. Infiltration is seepage of water into sewers from wet ground. Inflow is the inadvertent discharge of stormwater into the sanitary sewer system. The cities that contribute wastewater to the Santa Rosa regional system have already taken steps to reduce infiltration and inflow into their collection systems. Efforts to reduce infiltration and inflow still further would not eliminate the need to upgrade and expand the existing wastewater system.

The possibility of injection of wastewater deep into the ground was considered, but rejected, because there is no reason to believe the deep strata is permeable and testing program to determine the feasibility of injection would cost millions of dollars.

A number of different sludge handling processes were suggested by members of the public. Because all of the treatment/disposal modes discussed earlier would produce sewage

TABLE 4-1  
COST OF WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES<sup>a</sup>

<u>Alternative</u>	<u>Capital Cost</u> (\$ million)	<u>Operation &amp; Maintenance Cost</u> (\$ million/yr)	<u>Revenue</u> (\$ million/yr)	<u>Total Present Worth</u> (\$ million)
1 Reuse at Geysers	92	17	Unknown	275 <sup>b</sup>
2 Indirect Disposal to Russian River	72	7	0	142
3 Disposal to Pacific Ocean	97	7	0	160
4 Disposal to San Pablo Bay	127	7	0	196

<sup>a</sup>Costs expressed in 1990 dollars.

<sup>b</sup>Does not include revenue from sale of water to the geothermal operators.

sludge as a by-product, the issue of sludge disposal does not enter into the evaluation of wastewater management alternatives. Sludge disposal is discussed in a subsequent report section.

### 4.3 COST OF WASTEWATER MANAGEMENT SYSTEM ALTERNATIVES

The estimated costs of the wastewater management system alternatives are shown in Table 4-1. The cost estimates are described by the City's consulting engineers as between "order of magnitude" and budget level estimates. They are useful for comparative purposes but are not necessarily indicative of final project costs. Final costs could be up to 20% higher than estimated or 35% lower.

The table shows capital costs, operation and maintenance costs and present worth costs. Capital costs are the sum of the costs of land acquisition and construction, engineering and legal services and all other costs incurred prior to start-up of the new system. Operation and maintenance costs are the sum of the annual costs for labor, energy, spare parts and repairs needed to keep the system running.

The most useful estimate, when comparing alternatives, is the total present worth. The total present worth is a measure of the total cost of construction, operation and maintenance and equipment replacement over a twenty-year period. Based on present worth, Alternative 2, indirect disposal to the Russian River is the least costly. Alternative 3, ocean disposal is 14% more expensive than the least cost alternative. Because cost estimates made during preliminary engineering are only accurate to within about 25% these two alternatives could be regarded as about equally costly. The estimated cost of the remaining alternatives, Alternatives 1 and 4, are 37% and 93% greater than the least cost alternative. The true cost of Alternative 1, reuse at the Geysers, is not known, however, because it has not been possible to estimate the revenue from the sale of the water to the geothermal industry.

### 4.4 SLUDGE TREATMENT AND DISPOSAL

Wastewater solids or sewage sludge is produced as a by-product of wastewater treatment. Raw sewage sludge is a soupy liquid that decays rapidly, and, if handled improperly, will produce unpleasant odors. At the Laguna plant, the sludge is digested and dewatered before being loaded into trucks and conveyed to the Central Sonoma County Landfill for disposal. Sludge digestion reduces its volume and vulnerability to decay. Dewatering dries the sludge to a fibrous, earthy smelling solid.

All of the long-range wastewater management alternatives would produce sludge. In 1985 average daily production was about 12 dry tons. Corresponding production figures for 1990 and 2010 are 15 and 21 dry tons, respectively. Recent tests have demonstrated that the levels of toxic materials in Santa Rosa's sludge are very low and consequently the sludge is not regarded as a hazardous waste.

CH2M-Hill analysed a number of long-range sludge management alternatives for the Santa Rosa region, some of which were suggested by members of the public.<sup>4</sup> Alternatives considered included continued landfilling of sludge, composting for sale as soil amendment, agricultural use of dewatered sludge, incineration and oil-immersion dehydration (the Carver-Greenfield). The cost of the alternatives varies widely. The alternatives that employ relatively sophisticated technology would be three to ten times more expensive than the simpler alternatives such as landfilling or agricultural use. The costs of the alternatives considered in detail by CH2M-Hill are shown in Table 4-2. CH2M-Hill recommends that the City of Santa Rosa gradually switch from the present practice of landfilling to private processing of dewatered sludge for agricultural use over the next five to ten years. The reasons for the change are twofold. First, landfill disposal can be expected to become more expensive in the future as environmental regulations become more stringent and nearby landfills reach capacity. Second, landfilling does not take advantage of the value of sludge as a resource. The City would pursue arrangements with private companies that wish to further process the sludge for sale and agricultural use. If private processing proves infeasible, the City would undertake processing and sale itself. The City's goal would be to substantially reduce or eliminate landfill disposal of sludge by the early 1990s.

Because the long-range sludge management plan cannot identify, at this stage, locations at which dewatered sludge would be used, the environmental impacts of the long-range plan are not considered in detail in this report. The impacts are discussed in general terms in Chapter 20 together with some improvements to the sludge management system that must be made immediately.

### 4.5 CONSTRUCTION METHODS

The precise method of construction to be used in building the project alternatives would be established by the City's design engineer and construction contractors when the final construction documents are completed. The most likely methods of construction are described below and serve as a basis for the impact assessment.

TABLE 4-2  
COST OF SLUDGE TREATMENT ALTERNATIVES<sup>a</sup>

<u>Alternative</u>	<u>Description</u>	<u>Total Present Worth (\$ million)</u>
LA-3 <sup>b</sup>	Private processing of dewatered sludge for agricultural use	2.7
LF-2	Landfilling of air-dried sludge	3.4
LF-1	Landfilling of dewatered sludge	3.6
LA-2	City processing of dewatered sludge for agricultural use.	5.1
LF-4	Dedicated sludge landfill	6.3
LA-5	Aerated static pile composting	10.1
I-2	Incineration of air-dried sludge	10.9
LF-3	Landfilling of aerated static pile compost	16.1
LA-1	Dedicated land disposal of dewatered sludge	16.9
LA-4	In-vessel composting	18.6
I-1	Incineration of dewatered sludge	24.1
I-3	Oil-immersion dehydration and energy recovery (Carver-Greenfield Process)	29.5

<sup>a</sup>Costs expressed in 1990 dollars.

<sup>b</sup>Alternative designations used in CH2M-Hill reports

### 4.5.1 TREATMENT PLANT EXPANSION AND IMPROVEMENT

All of the alternatives include expansion of the existing Laguna treatment plant on Llano Road. Some of the alternatives involve the construction of entirely new process units. With the exception of the overland flow system, all the new or expanded treatment facilities would be built within the boundaries of the existing plant.

The new construction would consist of concrete tanks, mechanical equipment and buildings generally similar to those already at the site. Construction work at the site would continue for 18 to 24 months and would involve a maximum of 100 workers at any one time. Workers would commute to the site and usually work eight-hour days, five days each week. Equipment likely to be used would include backhoes, air compressors, welding machines, cranes and various air or electrically-powered hand tools. Concrete would be delivered to the site by ready-mix trucks. Concrete reinforcing steel and mechanical and electrical components would also be delivered by truck. Pile-driving equipment may be used during construction of foundations.

### 4.5.2 RAPID INFILTRATION SYSTEM

The rapid infiltration system would probably be constructed on land currently used as orchards or vineyards. The land would be graded to form a number of ponds. Most of the land surface would be altered and the existing vegetation destroyed.

Construction of the rapid infiltration system would take about 6 months and would involve a construction crew of about 20. Equipment used would include scrapers, graders and backhoes.

### 4.5.3 PIPELINES

Most of the pipeline construction would take place within highway rights-of-way. Exceptions might occur at stream and river crossings and where the rights-of-way are narrow or steep. Pipelines would be built by a crew of approximately 20. Several crews might work on different sections of the pipeline simultaneously. Trenches would typically be 6 feet wide and about 8 feet deep. The total width of the working corridor would be 25 to 50 feet including the trench. Construction would occur in sections and would last about 4 weeks at any particular location. Equipment would include backhoes, dump trucks, loaders, small cranes, water trucks and rollers.

### 4.5.4 OUTFALLS

The outfalls are pipelines extending into the Bay or ocean. They would be 42 to 48 inches in diameter. The portion of the outfall that crosses the beach or marshland would be installed in a trench in a similar way to the pipelines. The portion that passes through shallow water or the surf zone would probably also be installed in a trench, but from a temporary trestle. The deepwater portions would be lowered into place from a barge. A construction staging area of about 5 acres would be needed at, or near, the beach. Construction would take 8 to 12 months and would involve a crew of 30 to 50.

An alternative construction method for the off-shore portions of the outfalls is the bottom-pull method. Pipe is assembled on-shore and pulled into place from an anchored barge. The time required for construction, and the crew size, would be the similar for both construction methods.

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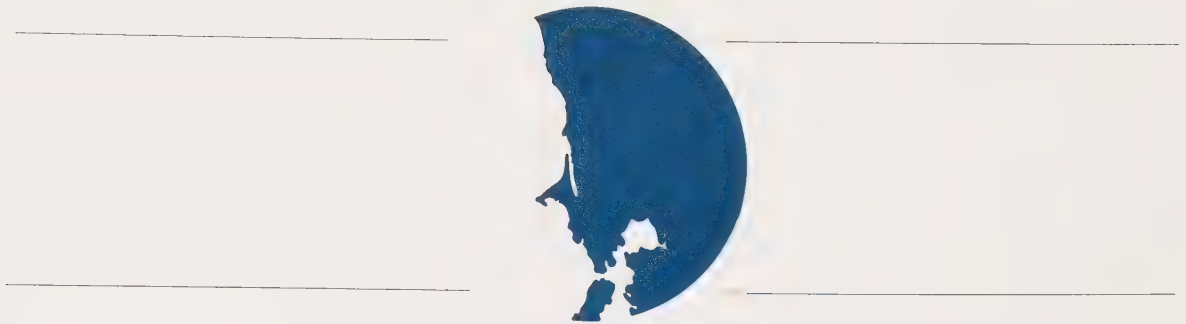
<sup>1</sup>Long-Term Study of Treatment and Disposal Alternatives, Phase I, Preliminary Analysis of Alternatives, CH2M-Hill, 1986.

<sup>2</sup>Environmental Evaluation, Long-range Wastewater Management Alternatives, EIP Associates, 1986.

<sup>3</sup>Wastewater aerosols is the term used to describe wind-borne spray originating from wastewater. Although there is no evidence that the health of individuals exposed to wastewater aerosols is compromised, the possibility of disease transmission by this route exists.

<sup>4</sup>Sludge Disposal Study, Technical Memorandum T23, CH2M-Hill, 1986.





# THE SANTA ROSA REGION



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## 5 THE SANTA ROSA REGION

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### 5.1 INTRODUCTION

This chapter provides a general description of the region within which the impacts of the wastewater management alternatives would be felt. More detailed information on environmental setting is provided in subsequent chapters.

The four wastewater disposal alternatives under consideration are generally contained within Sonoma County; however, one proposed pipeline route would cross into Marin County, transporting treated wastewater into San Pablo Bay.

### 5.2 TOPOGRAPHY<sup>1,2</sup>

Sonoma County is situated within the Coast Ranges geologic province on the western edge of the North American Plate. The San Andreas fault separates the North American plate from the Pacific plate. The Coast Ranges is typified by strong northwest-southeast trends of faults, elongated ridges and narrow valleys. The present configuration of ridges and valleys in Sonoma County is related to a long history of extensive earth movement caused by the Pacific oceanic plate and the North American crustal plate pushing against each other, by erosion of the uplifted mass, and by changes in sea level related to periods of glaciation during Pleistocene time.

The County's coastal plains and three north-south valleys are divided by hills and mountains. Elevations range from sea level at the Pacific Ocean (the County's western boundary) to the 4,262-foot summit of Mount Saint Helena, at the Napa/Sonoma County line.

The proposed wastewater treatment alternatives share a common point of origin at the Laguna Treatment Plant on the Laguna de Santa Rosa Plain. The plain occupies a

depression in the Coast Ranges which separates the Mendocino Range on the west and the Sonoma Mountains on the east. The area west of the Laguna is generally moderate to steeply rolling terrain.

Alternative 1 proposes reuse of treated wastewater at geothermal geysers 40 miles north of the Laguna Treatment Plant. The proposed pipeline would follow a route with an elevation gain of nearly 3,000 feet. The Laguna de Santa Rosa Plain is flat; however, as the route proceeds northward, it would enter rolling foothills and the rugged, steep terrain of the Sonoma Mountains.

Alternative 2, indirect disposal to the Russian River, would be contained on flat land with the Laguna de Santa Rosa plain. Rapid infiltration system basins would be located on relatively flat land in the Russian River flood plain.

Alternative 3 proposes disposal of treated wastewater in the Pacific Ocean via two routes. The northern route would generally follow the Russian River from Forestville to the coast at Goat Rock. The terrain along the Russian River is very steep with slopes in excess of 30%. At the coast, a steep cliff drops to the beach, where an outfall would extend offshore.

The southern route would follow Bodega Highway from Sebastopol to Bodega, then Bay Hill Road to an outfall near Salmon Creek. The route from the treatment plant to Sebastopol would be flat on the Santa Rosa Plain, then rolling to mountainous through the Mendocino Highlands, to the Pacific Coast where the outfall is located.

Alternative 4, proposes disposing of treated wastewater into San Pablo Bay, in Marin County. The pipeline route would be on flat terrain within the Santa Rosa Plain and Petaluma Valley which opens out to San Pablo Bay.

### 5.3 CLIMATE<sup>1</sup>

Climate in Sonoma County is affected by regional climatic characteristics and geographic location. Migrating pressure units which form over the Pacific Ocean determine seasonal weather patterns. The Pacific High, is a high pressure area over the northern Pacific Ocean which changes position with the seasons. In the wet season, storms enter the

County due to the southern position of the Pacific High. In the dry season, storms are routed to the Pacific Northwest, due to the northern position of the pressure unit. As a result of the position of this Pacific High, the amount of seasonal precipitation, cloud cover, direction of prevailing winds, and fog conditions are determined.

The general flow of air through the San Francisco Bay Area also determines climactic patterns in Sonoma County. During the dry season, the combination of of a thermal low pressure area in the interior of the State and the Pacific High produces strong, steady winds off the ocean. When combined with the upwelling cold water near the coast, the flow of air through the San Francisco Bay area produces coastal fogs.

During the dry season winds are generally from the northwest. Low clouds and fog are produced and the prevailing wind transports air over upwelling, cold offshore water. Fog intrusion is most prevalent along the western edge of the County and inland to the valleys. The southern part of the County is subject to deep fog intrusion due to its proximity to San Pablo Bay where cold marine air enters the Bay and is pushed inland by winds from the west. Precipitation in Sonoma County is uncommon, if not rare, during the dry season. Occasionally measureable precipitation occurs in the mountains to the northeast and northwest. Temperatures in the County vary during the dry season. Cool, moist air along the coast keeps temperatures lower than in the interior valleys, where maximum tempertures often reach 100°F or more.

Winds prevail from the south during the wet season, bringing increased cloud cover, higher precipitation, and lower temperatures. Precipitation varies throughout the County during the wet season, with the heaviest amount being delivered to the coastal mountains. Annual precipitation averages 65-70 inches in this area, while the valleys record 30-35 inches per year. The southern portion of the County near San Pablo Bay receives 20-25 inches of precipitation per year. Fogs in the wet season occur primarily in the valleys and tend to be ground fogs rather than marine fogs which are common in the dry season. Temperatures during the wet season are relatively mild, with lows dipping to, or slightly below, freezing.

#### 5.4 LAND USE<sup>3,4</sup>

The Sonoma County Planning Department divides the County into 9 sub-County planning regions for the purpose of land use planning as discussed in Chapter 12.

Sonoma Coast/Gualala Basin is rich in natural resources, with land in agricultural production, commercial fishery resources, timber, sensitive landforms and watersheds, and scenic resources. Commercial areas are small-scale and located in community areas in a number of scattered locations along major roadways. Visitor-serving uses, such as lodgings, are dispersed in location and frequently sited near scenic coastal resources.

Cloverdale/N.E. County is located south of the Mendocino County Line. The Sonoma County geothermal geysers are located within the mountainous portion of this sub-County planning region. Vineyards and specialty crops are located within the Alexander Valley. The remainder of the region is open space, grazing, agriculture, and public lands. Communities include Cloverdale and Geyserville.

Healdsburg and Environs is in the north-central portion of the County. The City of Healdsburg and the Town of Windsor are located along U.S. 101 and include urban and rural residential densities. Vineyards and specialty crops are raised in within the flood plain of the Russian River; timberlands, open space, grazing and agriculture in the surrounding area.

The Russian River sub-County area is centrally located in the County. Rural residential and urban densities occur along the Russian River and Highway 116. Resorts, recreation and visitor-serving communities include the towns of Guerneville, Rio Nido and Monte Rio, on the Russian River. Land uses in the areas surrounding the Russian River primarily include natural resource conservation and timberlands. Some agriculture and specialty crops are also grown in the area.

Santa Rosa and Environs is the most urban of the sub-County planning areas. The City of Santa Rosa comprises much of the planning area; to the east and south, land uses are related to agriculture, natural resource conservation and rural residential. North of Santa Rosa land uses are primarily natural resource conservation and rural residential.

Sebastopol and Environs planning area is located between Santa Rosa and the Marin County line. The City of Sebastopol is urban in character with high density residential and commercial development. Land uses which surround the City include rural residential and buffers of agriculture; further south the land is less intensely developed and is generally used for grazing and forage crops.

Rohnert Park - Cotati and Environs is located adjacent to U.S. 101 between Santa Rosa and Petaluma. The planning area is characterized by urban and suburban development near the cities, and agriculture, grazing, rural residential, and natural resource conservation east of the urban area.

Petaluma and Environs is the southernmost planning region in the County, bordering Marin County. The City of Petaluma is urban in character and density. Rural residential development is occurring adjacent to and west of Petaluma. Urban expansion is not allowed north and east of Petaluma, which allows this area to remain in agriculture and grazing. Land use in the remainder of the area includes natural resource conservation, agriculture and grazing.

The Sonoma Valley is relatively rural in character and includes land uses which are associated with grape and wine production. Vineyards and specialty crops are located throughout the Valley; in addition, rural residential is intermixed with natural resource conservation, grazing and diverse agriculture. The Town of Sonoma, and communities of Boyes Hot Springs, Kenwood, Eldridge and Glen Ellen provide for higher residential densities.

### 5.5 POPULATION<sup>5</sup>

According to the Association of Bay Area Governments (ABAG) in "Projections '85", Sonoma County has experienced rapid population growth in the period from 1950 to 1980; during this time the population of the County has tripled, with nearly half of that growth occurring during the 1970's. Between April 1980 and April 1985, the population of the County increased by an estimated 32,600 people, or about 10.6%. By 2005, the population is expected to increase by approximately 147,000 residents or a 44% increase over the 1985 estimated population level of 332,300. Most of that growth is expected to be concentrated in the cities and their spheres of influence as well as in specific

unincorporated communities. (Chapter 16, Socioeconomics presents a detailed discussion of population within the County and its cities.)

## 5.6 EMPLOYMENT<sup>5</sup>

In the years since World War II, Sonoma County has experienced a shift in economic base, from agriculture and tourism as key sources of County income, to retail trade, services and manufacturing as the strongest employment sectors. Employment in the County's rural areas is, however, more dependent on agriculture and natural resource related employment than the cities.

Employment projections from ABAG have determined that the County's growth rate will increase annually, with the fastest job growth in Cotati and Rohnert Park. (For additional information on employment, refer to Chapter 16, Socioeconomics.)

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<sup>1</sup> Sonoma County Planning Department, Environmental Resources Management Element, Sonoma County General Plan, Volume 2, Natural Resource Inventory-Goals and Policies, October 1974.

<sup>2</sup> Sonoma County Planning Department, Landscape Units Map Index, Sonoma County General Plan, October 1974.

<sup>3</sup> Sonoma County Planning Department, Draft Land Use Element, Sonoma County General Plan, April 11, 1986.

<sup>4</sup> Sonoma County Planning Department, Draft Land Use Plan Maps for the 9 Sub-County Planning Areas, April 16, 1986.

<sup>5</sup> Association of Bay Area Governments, "Projections '85," 1985.



HYDROLOGY,  
WATER QUALITY  
& AQUATIC LIFE



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## 6 HYDROLOGY, WATER QUALITY AND AQUATIC LIFE

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### 6.1 INTRODUCTION

The project alternatives have been formulated to avoid water quality problems in the Russian River. Obviously, one of the primary impacts of the alternatives would be their effect on aquatic resources. The potential impacts on aquatic resources are discussed in three chapters of the report. In this chapter the general characteristics of the affected water bodies are described, together with the environmental regulations that affect them. The ability of the alternatives to meet the applicable water quality standards are discussed in the impact section. Chapter 7 is a discussion of how the alternatives might affect the health of drinking water consumers. Appendix A is a general discussion of wastewater and the environment that may be useful to a reader unacquainted with the subject.

### 6.2 SETTING

The project alternatives could affect flow and water quality in a number of different water bodies including the Pacific Ocean, San Francisco Bay and the Russian River and its tributaries. Groundwater could also be affected at the Geysers and in the Santa Rosa Basin.

#### 6.2.1 RUSSIAN RIVER

##### Hydrology

The Russian River drains a basin of 1,485 square miles in Sonoma and Mendocino Counties. The drainage basin, lying between adjoining ridges of the Coast Range, is about 80 miles long and from 10 to 30 miles wide. The total length of the river, from its source about 16 miles north of Ukiah to its mouth at Jenner, where it empties into the Pacific Ocean, is about 110 miles.<sup>1</sup> Principal tributaries of the Russian River are Dry Creek and

Mark West Creek. Dry Creek drains an area of 217 square miles in the west central portion of the drainage basin and empties into the Russian River about two miles south of Healdsburg. Mark West Creek, which includes the Laguna de Santa Rosa, drains an area of 254 square miles located in the southeastern portion of the drainage basin and joins the main stream at Mirabel Park. Other tributaries include the East Fork, Big Sulfur Creek, Maacama Creek, Mill Creek and Austin Creek.

River flows have been altered from their natural condition by a number of water resource development projects. Since 1908, water has been diverted from the Eel River and released into the East Fork of the Russian River through the Potter Valley Tunnel and Powerhouse. In recent years, the amount of water imported from the Eel River has averaged 162,300 acre-feet per year.<sup>2</sup>

Coyote Dam is located on the East Fork of the Russian River, just north of Ukiah. Lake Mendocino, the reservoir formed by the dam, stores about 122,500 acre-feet of water, and is used for water supply, recreation, flood control and augmentation of summer stream flows in the Russian River. The dam and reservoir were built by the U.S. Army Corps of Engineers in 1959.<sup>3</sup>

Warm Springs Dam was built by the Corps of Engineers in 1983, and is located on Dry Creek approximately 15 miles upstream from its confluence with the Russian River. Lake Sonoma, the reservoir formed by the dam, has a capacity of 381,000 acre-feet and is used primarily for water supply and flood control.

Streamflows in the Russian River basin vary widely from floods during the winter to small flows and even no flows during the dry summer months. Rainfall over the basin is considerable, averaging 41 inches per year. Eighty percent of the annual runoff occurs between December and March. Because winter storms often produce extended periods of intense rainfall over the river basin, flooding is frequent and severe. Between 1939 and 1970, nineteen damaging floods were recorded. This year, 1986, a record river flow of 102,000 cubic feet per second occurred at Guerneville, producing severe flooding.

On the other hand, tributary streams often dry up completely during the summer, although subsurface flow may still occur in the stream bed gravels. A minimum summertime flow of 125 cubic feet per second is maintained in the Russian River at Guerneville by releases from Lake Mendocino and Lake Sonoma. Summertime flow would be considerably less without these releases. Average monthly streamflows measured at Guerneville are shown in Table 6-1.

### Water Quality

The quality of water in the Russian River basin is good, although some degradation occurs as a result of failing septic tank systems, municipal wastewater discharges, urban stormwater runoff and agricultural runoff. River water has a relatively low mineral content. Its turbidity can be high during the high flow months, but is usually low during the summer except where it is affected by gravel mining operations. The numbers of fecal coliform organisms found in river water increases moving downstream. The concentrations of toxic substances in river water are low, although some increase in metals concentrations is evident near Wohler Bridge after rainstorms. Selected information on river water quality at Mirabel Heights is shown in Table 6-2.<sup>4</sup>

Protection of water quality in the Russian River basin is the responsibility of the California Regional Water Quality Control Board, North Coast Region. The Regional Board regulates wastewater discharges to the ocean in accordance with the water quality control plan or basin plan for the North Coast Region. The basin plan lists a number of uses of Russian River water that must be protected.<sup>5</sup> These uses, known as beneficial uses are municipal water supply, agricultural water supply, industrial water supply, aesthetic enjoyment, scientific study, preservation and enhancement of fish, wildlife and other aquatic resources, groundwater recharge and water contact and water associated sports.

### Fish and Other Aquatic Life

The Russian River and its estuary is known to support at least 46 species of fishes and are listed in Appendix B. Twenty-seven of these species are native. The native anadromous species include the steelhead trout, king or chinook salmon, silver or coho salmon, pacific lamprey, river lamprey, white and green sturgeon and the threespine stickleback.

TABLE 6-1  
MONTHLY STREAM FLOWS FOR THE RUSSIAN RIVER<sup>1</sup>  
AT GUERNEVILLE (cfs)

<u>Month</u>	<u>1959-1983<sup>2</sup></u>	<u>1975-1976</u>	<u>1976-1977</u>
October	340	389	152
November	1,864	386	163
December	4,722	531	116
January	7,777	300	127
February	6,556	502	88
March	4,801	943	201
April	2,532	775	48
May	559	151	39
June	251	150	23
July	174	146	32
August	177	144	37
September	190	141	36

<sup>1</sup>Source: U.S. Geological Survey Water Resources Reports.

<sup>2</sup>Annual Average

TABLE 6-2  
WATER QUALITY AT RUSSIAN RIVER AT MIRABEL HEIGHTS

<u>Year</u>	<u>Specific Conductance (umho/cm) at 25 degC</u>	<u>Turbidity (NTU)</u>	<u>Total N03 - N (mg/L)</u>	<u>Total Organic Nitrogen (mg/L)</u>	<u>Soluble Ortho PO4 (mg/L)</u>	<u>Phytoplankton Count (cells/mL)</u>
1973	265	5	0.66	0.46	1.50	100
1974	270	7	0.40	0.38	0.39	100
1975	243	8	0.19	0.30	a	<100
1976	255	9	0.10	0.24	a	<100
1977	325	4	0.03	0.16	0.03	1200
1978	260	3	0.15	0.36	0.03	2300

Introduced anadromous species include the American shad and the striped bass. Steelhead and salmon are known to spawn in the tributaries of the River, however the striped bass and sturgeon are believed to use the river for feeding only and not for spawning. The Russian River drainage is one of the most important salmon spawning waterways in the central coastal region. Dry Creek, above the confluence with the Laguna de Santa Rosa, is the most important spawning tributary in the basin. The Warm Springs Dam on Dry Creek was projected to prevent the upstream migration of 6,000 steelhead trout and 100 coho salmon per year.<sup>3</sup> The fish hatchery at the base of the dam was projected to fully mitigate the loss of the steelhead trout and increase the run of coho salmon over time. The change in winter flood flows and summer flows downstream of the dam will both favor migrant fish by creating summer rearing and resting habitat as well as hinder migrant fish by promoting the immigration of predatory species not currently found in this creek.

The native non-anadromous or resident species include the California brook lamprey, Western sucker, species of minnows, tulepurch, sculpins, and the Sacramento perch. Introduced species adapted to warm water, include three species of minnows, four species of catfish, mosquitofish, two species of crappie, three species of sunfish, and two species of bass.

Cover or shelter for fish in the form of riparian vegetation, undercut banks, boulders, etc. are scarce on the main stem of the river. The pool to riffle ratio on the main stem is much greater than that which is typical of nursery habitat for trout, and salmon. The summer water temperatures are too high for trout and salmon for most of the main stem. Most of the trout and salmon reproduction occurs in the tributaries and the far upper reaches of the main stem.

### 6.2.2 LAGUNA DE SANTA ROSA

#### Hydrology

The Laguna de Santa Rosa is a significant hydrologic feature of the Lower Russian River basin. The Laguna is a wide, marshy area lying along the western edge of the Santa Rosa Plain that acts as a natural flood control basin for the Russian River. It drains to the Russian River via Mark West Creek.

The Laguna de Santa Rosa is the only large freshwater wetland not associated with a permanent water body in the Russian River Basin. Generally, it is important because it is a wetland, a dwindling resource in California, and specifically important because it supports a number of plant and animal species not found in other parts of the basin and in some cases rarely found in other parts of California.

During storms the Laguna becomes a lake, temporarily storing water that would otherwise increase flood peaks further down the Russian River. As the water level in the Russian River rises, water backs up into the Laguna impeding downstream flow from the Laguna watershed itself. On average, a lake is formed every other year in the Laguna with a depth of 22 feet at the confluence with the Russian River. During the December 1964 - January 1965 storms, the Laguna became a lake with a surface area of 7,400 acres and a capacity of 80,000 acre-feet. It is estimated that the Laguna storage reduced downstream Russian River flow by approximately 40,000 cfs and decreased the flood crest at Guerneville by 14 feet.

The Laguna de Santa Rosa has suffered from a lack of clear definition in the past. The head waters of the Laguna are located in the hills south and east of the City of Santa Rosa. The creek then enters the Santa Rosa Plateau near Stony Point Road and meanders to the north. Immediately west and north of the City of Santa Rosa, the Laguna de Santa Rosa merges with Mark West Creek. It is at this point that confusion begins. Some have referred to the waterway as Mark West Creek from this point to the Russian River, and others have referred to the creek as the Laguna de Santa Rosa. For purposes of this report, the Laguna de Santa Rosa is defined as that area of the Santa Rosa Plateau below elevation 75 feet, located between Stony Point Road to the south and River Road to the north.

Land in the Laguna de Santa Rosa is used primarily for agricultural and preserved open space for native vegetation and wildlife management. During summer months, the Laguna becomes a slow-flowing stream confined within a narrow channel.

Currently, the City of Santa Rosa's Laguna Treatment Plant releases treated wastewater directly into the Laguna de Santa Rosa during the winter months. These discharges are limited to 1% of the Russian River flow, but sometimes represent a much higher

proportion of flow in the Laguna. During the summer months, a portion of the treated wastewater is used to irrigate pasture in the Laguna. Subsurface flow from the irrigated pasture helps to sustain summer flow in the Laguna and surrounding lands that would otherwise become arid.

### Water Quality

A recent study examined the quality of water in the Laguna de Santa Rosa.<sup>6</sup> Water quality, while often falling short of basin plan objectives is at a level to be expected under prevailing environmental conditions. The relatively poor water quality conditions are thought to be the result of agricultural practices in the surrounding areas rather than as a result of wastewater discharge.

### Aquatic Life

The fish life in the Laguna de Santa Rosa is representative of warm, slow moving waters. A list of fish presently known to occur in the Laguna is presented in Table 6-3. The two anadromous fish, steelhead trout and coho (silver) salmon migrate up as far as Mark West, Windsor, and Santa Rosa Creeks.

The anadromous fish runs in the Laguna de Santa Rosa are believed to have extended further up the Laguna in the past. Reasons for the reduction in the run are not well understood, however two factors are now believed to have played a principal role; changes in water temperature, and changes in the chemical makeup of the waters. The past practices of clearing riparian vegetation has exposed the waters of the Laguna to greater solar heating. Anadromous fish are known to respond to water temperature in their migration and spawning habits. The increases in water temperature may act as barriers to anadromous fish that once spawned in tributaries above the Laguna.

Some people believe that the release of the secondary treated effluent into the Laguna alters the chemical makeup of the Laguna waters to effectively block the migration of anadromous fish beyond Santa Rosa Creek. It is not possible to say for sure that this practice has not adversely effected the run in the past. A fish avoidance study is now underway to determine if the treated wastewater effluent released into the Laguna may block or alter the migration of fish. A draft report of initial findings has been presented

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TABLE 6-3  
LIST OF FISHES OF THE LAGUNA DE SANTA ROSA<sup>1</sup>

Black chub	<u>Orthodon microlepidotus</u>
Carp	<u>Cyprinus carpio</u>
Western sucker	<u>Catostomus occidentalis</u>
Sacramento roach	<u>Hesperoleucus symmetricus</u>
White catfish	<u>Ictalurus catus</u>
Bluegill	<u>Lepomis macrochirus</u>
Largemouth black bass	<u>Micropterus salmoides</u>
Steelhead trout	<u>Salmo gairdneri</u>
Silver salmon	<u>Onocorhynchus kisutch</u>

Prepared with the assistance of Dr. John Hopkirk of the Sonoma State College Biology Department and Ron Church of the California State Department of Water Resources.

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<sup>1</sup>Laguna de Santa Rosa Environmental Analysis and Management Plan, 1977, Sonoma County.

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to the City of Santa Rosa. The preliminary laboratory results indicate that dilution levels of 1% or greater caused some avoidance behavior. There did not appear to be any significant change in the avoidance reactions of the fish at higher dilutions, however. In fact, at a dilution level of 10% no avoidance behavior was observed. An explanation for these findings was not suggested except to postulate that the fish do have a tolerance level and this tolerance level may vary.

A recent study by the North Coast Regional Water Quality Control Board concluded that the relatively poor water quality of the Laguna could not be attributed to any identified waste discharge.<sup>6</sup> The high bacteria levels in the Laguna and Santa Rosa Creek are believed to have been introduced by livestock, wildlife and other exogenous sources, and were not considered to be of wastewater origin. Elevated phytoplankton densities and nutrient levels are believed to be normal water quality conditions in these waters and not associated with any treated effluent discharge. In addition, there have been no recent reports of large fish kills associated with effluent discharges in these waterways, suggesting that the water quality is generally not harmful to the fish. Prior to 1986, when the effluent released into the Laguna and Santa Rosa Creek was not dechlorinated, there were many reports of fish kills. When it was determined that the kills were a result of the chlorinated effluent, the City installed a dechlorination process to eliminate the problem.

### 6.2.3 PACIFIC OCEAN

#### Oceanography

The nearshore waters of the Pacific Ocean between the mouth of the Russian River and the mouth of Salmon Creek are a potential disposal site for treated wastewater. The character of seawater in this area is influenced by large-scale water movements in the northern Pacific Ocean. Waters from the Subarctic and North Pacific water masses are carried into the area by the southward flowing California Current. The coastal waters are cool, as might be expected considering their origin in the north. Maximum water temperatures usually occur in August or September, and are in the range of 55°F. Periods of minimum temperatures often occur in the Spring, when upwelling takes place. Upwelling is a phenomenon caused by strong winds that drive surface waters away from the coast. Cold nutrient-rich waters from the bottom of the ocean rise, replacing the surface waters. In November and December, the effects of the Davidson Current, a weak, warm, northward flowing current are usually felt in the area.

Localized eddies or current gyres are reported to exist south of Bodega Head. Current measurements made by the National Oceanic and Atmospheric Administration, off the mouth of the Russian River and near Sea Ranch, indicate that there are frequent current reversals along an axis parallel to the coastline. These results suggest that nearshore gyres are probably occurring along the Sonoma coast.

#### Water Quality

Water in the potential discharge area is cold and turbid with visibility usually limited to about 5 feet. Water quality is influenced during the winter months by freshwater outflow from the Russian River, Salmon Creek and numerous small streams.

Protection of nearshore water quality is the responsibility of the California Regional Water Quality Control Board, North Coast Region. The Regional Board regulates wastewater discharges to the ocean in accordance with the water quality control plan for ocean waters of California, usually referred to as the "Ocean Plan".<sup>7</sup> The Ocean Plan lists a number of uses of ocean waters that must be protected. These uses, known as beneficial uses, are recreation, aesthetic enjoyment, navigation, industrial water supply, and preservation and enhancement of fish, wildlife and other marine resources.

#### Marine Life

The offshore surface sediments consist of fine and coarse sands to approximately the 120-foot depth, and silt/clay sediments beyond the 120-foot isobath to the 360-foot isobath. Rocky intertidal areas occur nearshore at the Bodega Marine Preserve, Coleman Beach, Goat Rock, and within the Russian River Estuary. Data on species composition and distribution of the subtidal biota are scarce, however, the shifting, unstable nature of the sediments are expected to support a biotic community of much less diversity than the intertidal areas. In addition, the pelagic (non-attached) component of the subtidal fauna is often seasonal in its occurrences and difficult to observe because of their mobility. The typical biota of the intertidal areas, on the other hand, are better understood and well documented. The most detailed account of both the shallow subtidal and intertidal biota has been developed for the Bodega Marine Life Refuge, an Area of Special Biological Significance (ASBS). Extensive lists of species found here are presented in a reconnaissance survey report published in June 1979.<sup>8</sup>

A survey of the marine environment between Fort Ross, Sonoma County and Point Lobos, Monterey County indicated that the portion of the Sonoma County coastline between the mouth of the Russian River and Bodega Head had a higher abundance and diversity of fish than areas to the south.<sup>9</sup> The most important commercial and sport fisheries within this stretch of coastline are listed in Appendix B.

Anadromous fish that occur in this stretch of coastline include; steelhead trout, chinook or king salmon, coho or silver salmon, shad, pacific lamprey, striped bass, and sturgeon. Anadromous fish migrate up specific creeks or rivers to spawn and then return to the sea. Each time an anadromous fish reproduces it returns to its specific spawning waterway. The principal spawning waterways in the study area and the anadromous fish using these waterways are listed in Table 6-4 and shown in Figure 6-1.

This stretch of California coastline supports a rather large commercial and sport fishery. The commercial fishery off this stretch of coast is centered in the Bodega Bay and Bodega Harbor areas. The principal commercial fish species caught in the study area are listed in Appendix B.

The flat sandy-bottom areas off the coast between the Golden Gate and the mouth of the Russian River are known to support breeding populations of Dungeness crab, an important commercial species. Areas of note include Bodega Bay, Tomales Bay and the mouth of the Russian River.

The principal sport fish caught in this area include salmon on the Russian River and Salmon Creek, steelhead trout in anadromous waterways, rockfish on partyboats off the mouth of the Russian River, and to a very limited extent striped bass on the Russian River and in the coastal waters. Other sport fish include California halibut, lingcod, jack mackerel, white croaker, searperch and cabezone. Surf fishing for smelt, and diving for abalone also occur in some areas along the Sonoma County coastline.

This stretch of the Sonoma coastline has a number of sensitive and rather unique aquatic communities including the rocky intertidal zone, mud flats, and salt to freshwater marsh communities within the Russian River and Salmon Creek estuaries and Bodega Bay.

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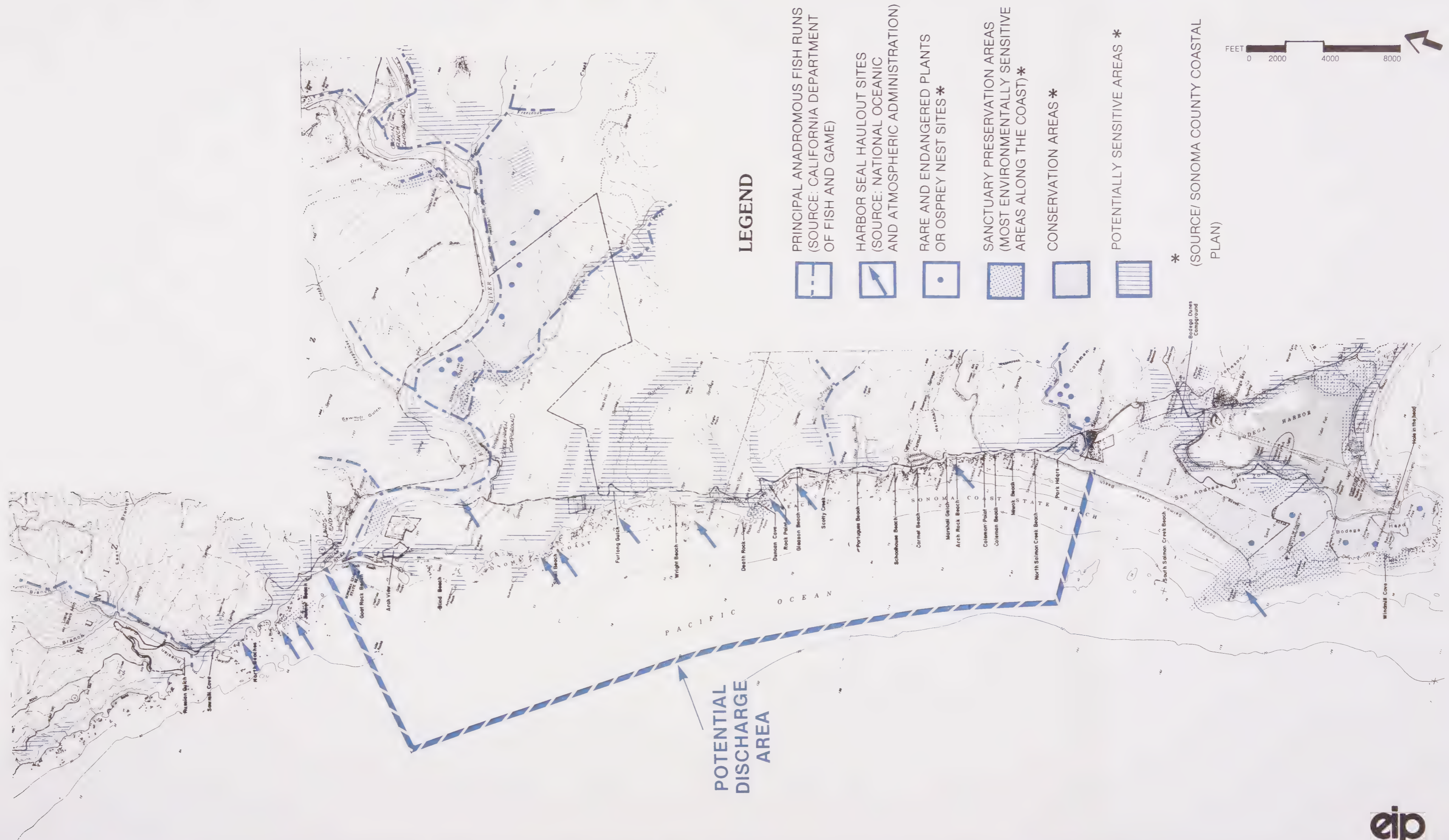
TABLE 6-4  
SPAWNING WATERWAYS AND ANADROMOUS FISH

<u>Waterway</u>	<u>Fish Species</u>
Russian Gulch -	steelhead, coho salmon
Russian River -	steelhead, chinook & coho salmon, shad, striped bass, sturgeon, pacific lamprey
Salmon Creek -	steelhead, coho salmon
Stemple Creek -	steelhead, striped bass
Walker Creek -	steelhead, coho salmon
Scotty Creek -	steelhead

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## SIGNIFICANT BIOTIC RESOURCES OF THE COAST

FIGURE 6-1





The rocky intertidal zone of the ocean coastline is an important rearing area for the larva and juveniles of many oceanic wildlife species. There are many wildlife species that are restricted to the intertidal conditions of this community. The largest and most significant intertidal communities in the subject stretch of coastline occur at the Bodega Marine Preserve, Coleman Beach, Goat Rock, and within the Russian River Estuary.

There are two estuaries and one natural bay on this stretch of coastline. Bodega Bay is located just south of Salmon Creek, and both the Russian River and Salmon Creek have natural estuaries near the coastline. There are two mud flat areas in the subject stretch of coastline in Bodega Harbor and the Bodega Marine Reserve. Mud flat communities are important feeding areas for shore birds, and at high tide, waterfowl. They typically support large populations of invertebrates in the mud substrate. Mud flats are also areas of high biological productivity contributing to nutrients and other organic compounds to the larger estuarine community.

Bodega Bay and the two estuaries noted above have freshwater, salt, and brackish water marshlands. These marshlands are important wildlife areas in that they provide habitat for a number of aquatic species that migrate between the salt water habitat of the ocean and the freshwater habitat of the Russian River and Salmon Creek. Shore birds and water fowl also utilize these areas for feeding, nesting, and resting.

The University of California's Bodega Marine Laboratory is located just south of the potential discharge area at Bodega Head. The marine laboratory lies partly within the Bodega Marine Life Refuge and is used by the university for marine research and teaching.

### Rare and Endangered Species

The California freshwater shrimp (*Syncaris pacifica*) is an endangered species known to occur along Salmon Creek, Green Valley Creek and tributaries of Atascadero Creek. This animal species is protected under the California Endangered Species Act of 1970.

Although a large number of the 111 described species of marine mammals undoubtedly enter these coastal waters at times, the most common and abundant are the harbor seals and sealions. Sizable resident populations of harbor seals occur at a number of hauling areas along this stretch of coastline. The largest and most frequently used seal hauling

areas are indicated in Figure 6-1. The California sea lion, and the Stellar sea lion are seasonal in occurrence, leaving the area in June and July to breed. Grey, humpback, and blue whales are known to migrate through the coastal waters in the area. Minke and killer whales are known to occur in these waters as well as Dalls porpoise, Northern right whale dolphin, Risso's dolphin, white-sided dolphin and harbor porpoise. All these marine mammals are protected under the Marine Mammals Protection Act. The grey, blue and humpback whales are also protected under the Endangered Species Act.

### 6.2.4 SAN PABLO BAY

#### Hydrology

The San Francisco Bay Delta System is generally regarded as the most important water body in California. It is used extensively for both recreational and commercial purposes and supports a diverse flora and fauna. About 40% of the land in California drains into the Bay and that land is the origin of water for most of the agriculture and cities of California. San Pablo Bay, one of the potential disposal points for treated wastewater, is part of San Francisco Bay.

San Francisco Bay has been greatly altered from its natural condition by man's activities.<sup>10</sup> Between 1853 and 1884, hydraulic mining of gold in the Sierra Nevada washed tens of millions of tons of sand and mud into San Francisco Bay, reducing the extent of open water and creating new mud banks. Later, much of the tidal marsh surrounding the Bay was filled for urban and agricultural use. In this century, as industry expanded and urban sewerage systems were built, increasing quantities of wastewater were discharged to the Bay. Freshwater inflow to the Bay diminished, as large quantities of water were diverted, and exported to the San Joaquin Valley and Southern California for urban and agricultural use. Despite these changes, the Bay remains a prized natural resource.

Water movements in the Bay result primarily from tidal currents as ocean waters enter and leave the Golden Gate. They remain fairly constant through the year, although they are influenced by freshwater flood flows and winds. Currents are strongest in the deepwater channel that runs through the center of the Bay.

### Water Quality

The quality of the waters of San Pablo Bay vary seasonally. For most of the year, water quality is similar to that of the waters of the Pacific Ocean. From December through April, water quality is affected by freshwater inflow from the Sacramento-San Joaquin delta and from other, smaller, tributaries including the Petaluma and Napa Rivers and Novato, Gallinas and Sonoma Creeks. The salinity of San Pablo Bay waters, usually in the range of 30,000 to 35,000 mg/l, drops to about 20,000 mg/l during the period of freshwater inflow.

The government agency responsible for protecting the health of San Francisco Bay is the Regional Water Quality Control Board, San Francisco Bay Region. The Regional Board has prepared a water quality control or "basin" plan that serves as a blueprint for water pollution control activities in San Francisco Bay.<sup>11</sup> The basin plan identifies a number of uses of San Pablo Bay that must be protected. These uses, referred to as beneficial uses, are non-contact recreation, wildlife habitat, preservation of rare and endangered species, estuarine habitat, warm freshwater and cold freshwater fish habitat, fish spawning and migration, industrial service supply, navigation and commercial and sport fishing. To protect the beneficial uses the Regional Board requires dischargers to San Pablo Bay to meet certain effluent limitations.

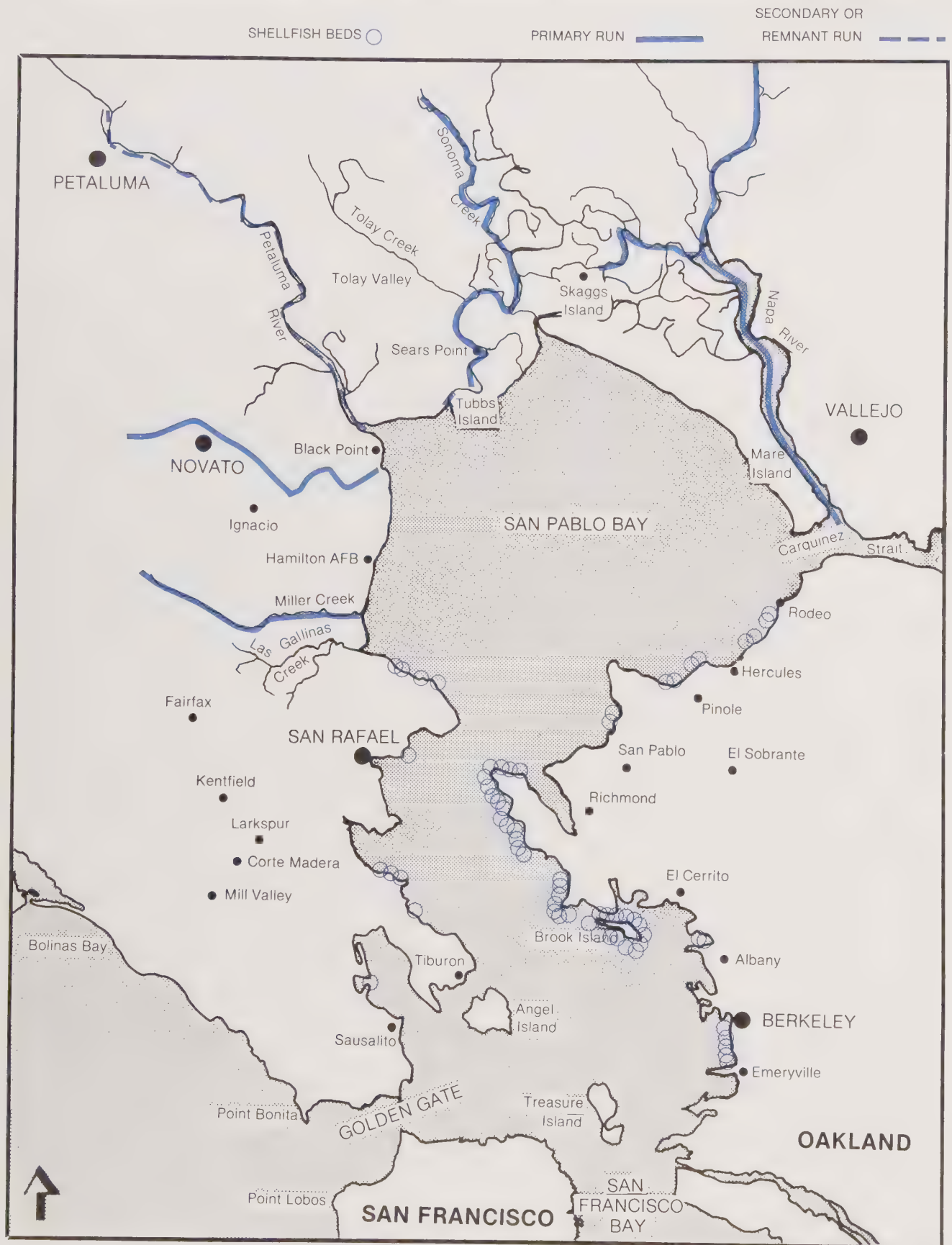
### Estuarine Life

The primary anadromous fish spawning waterways in the San Pablo Bay include: Miller and Novato Creeks in Marin County; Sonoma Creek in Sonoma County; and the Napa River and Huichica Creek in Solano County (see Figure 6-2). Steelhead trout spawn in all these fresh water courses and Chinook (King) salmon spawn in Sonoma Creek and the Napa River. San Pablo Bay and the other freshwater creeks and rivers around the Bay serve as nursery grounds for the anadromous fish noted above as well as for green and white sturgeon, Coho (silver) salmon, American shad, and striped bass. A remnant run of steelhead trout occurs in the Petaluma River to Adobe Creek, however this run has been limited due to the poor water quality in the Petaluma River.

The San Pablo Bay is part of the San Joaquin and Sacramento Rivers spawning run, one of the largest and most important anadromous fish runs on the Pacific Coast. Anadromous

# ANADROMOUS FISH RUNS AND SHELLFISH BEDS

FIGURE 6-2



MILES 0 2.5 5 10

SOURCES: WATER QUALITY CONTROL BOARD -  
 SAN FRANCISCO BAY REGION, 1975;  
 AND CALIF. DEPT. OF FISH & GAME, 1985

eip

fish runs occur throughout the year in the Bay. The shallow waters and mud flats of San Pablo Bay are important feeding and nursery areas for not only anadromous fish but for all the marine life occurring in the Bay. The migration and spawning season for the anadromous fish in the Bay are listed in Appendix B, together with the importance (and monetary value) of these fisheries to the state.

The San Francisco Bay is a nonstatic estuary system with water salinities and temperatures changing with the seasons, levels of freshwater inflows, and tidal cycles. Consequently, any classification of an area within the estuary would only be valid for a period of time before it shifts to another classification. However, based upon the chlorinity readings of two years, San Pablo Bay has been classified as a polyhaline or somewhat less than marine habitat.<sup>12</sup> Because of its location, San Pablo Bay is a region of transition between the marine habitats of the ocean, and the freshwater habitats of the San Joaquin and Sacramento Rivers. Regions of habitat transitions and sharp physical gradients typically support a flora and fauna recruited from nearby habitat types. San Pablo Bay supports a fish and invertebrate fauna recruited principally from the marine habitat with a few species from the freshwater habitats. Marine species and species which can tolerate a wide range of salinity levels (euryhaline) are the most common species of fish in San Pablo Bay. The populations of these fish fluctuate as the salinity level changes through the seasons.

In a survey conducted in 1963 and 1964 from San Pablo Bay to the confluence of the San Joaquin and Sacramento Rivers, 60 species of fish were recorded.<sup>12</sup> Of these 31 were saltwater or marine forms, 8 were euryhaline forms, 13 were freshwater forms, and 8 were anadromous. Those fish species found in greatest abundance in San Pablo Bay are listed in Table 6-5. Figure 6-3 shows herring spawning and shrimp harvesting areas.

Some of the most important fish and invertebrate species in terms of commercial or sport fishing are the Pacific herring, Northern anchovy, English sole, starry flounder, Dungeness crab, shrimp, clams and oysters. Additional information on the fisheries can be found in Appendix B.

### 6.2.5 GROUNDWATER AT THE GEYSERS

The Geysers is the only successful geothermal power facility in the United States, especially noted for its production of dry steam. The field is located approximately forty miles north of Santa Rosa in the Mayacamas Mountains of Sonoma County and portions of Lake and Mendocino Counties. Geothermal power has been produced there since 1960. Today the Geysers is generating 1,100 megawatts of electricity with a capacity of 2,000 megawatts.

The subsurface geology in the Geysers area consists of northwest-trending folded and faulted blocks and thrust plates. Thermal activity is concentrated along but not confined to the Big Sulfur Creek fault zone. Steam is produced from the Franciscan formation, a thick assemblage of sandstone, mudstone, greenstone, chert, conglomerate and limestone. The Franciscan is characterized by extensive faulting and fracturing, as well as heating at great depth by a body of magma.

Overlying and in thrust contact with the Franciscan is the Great Valley sequence, composed of igneous rocks and marine sedimentary rocks. Also present in this zone are Tertiary age sedimentary rocks, the Sonoma Volcanics of Pliocene age, and scattered exposures of non-marine sedimentary rocks of Pliocene to Holocene age.

The Geysers area is characterized by thermal springs (112°F-212°F) and mineralized groundwater. Geothermal wells at the Geysers generally tap steam from two zones, a shallow zone about 500 to 3,000 feet deep and a deeper zone, 5,000 to 6,000 feet deep. These zones in many areas are capped by impervious materials, so very little groundwater recharge occurs. As a result, field pressures have declined substantially. Operators in the area have been attempting to abate steam pressure decline for a number of years by injecting power plant condensate and surface water into the steam reservoirs. The quantity of water, however, has been insufficient to prevent pressure decline. Therefore, an external supply of injection water is needed.

Some surface evidence of thermal waters does exist in the Geysers area, represented by hot springs and fumaroles along isolated fault zones. It is thought that these mineralized thermal waters leak from the shallow steam reservoir. The deeper reservoir has a more efficient seal due to the increased depth and cementation of silica and calcium carbonate in fractures, and leakage from the deeper reservoir is therefore considered minimal.

TABLE 6-5  
FISH OF SAN PABLO BAY<sup>1</sup>

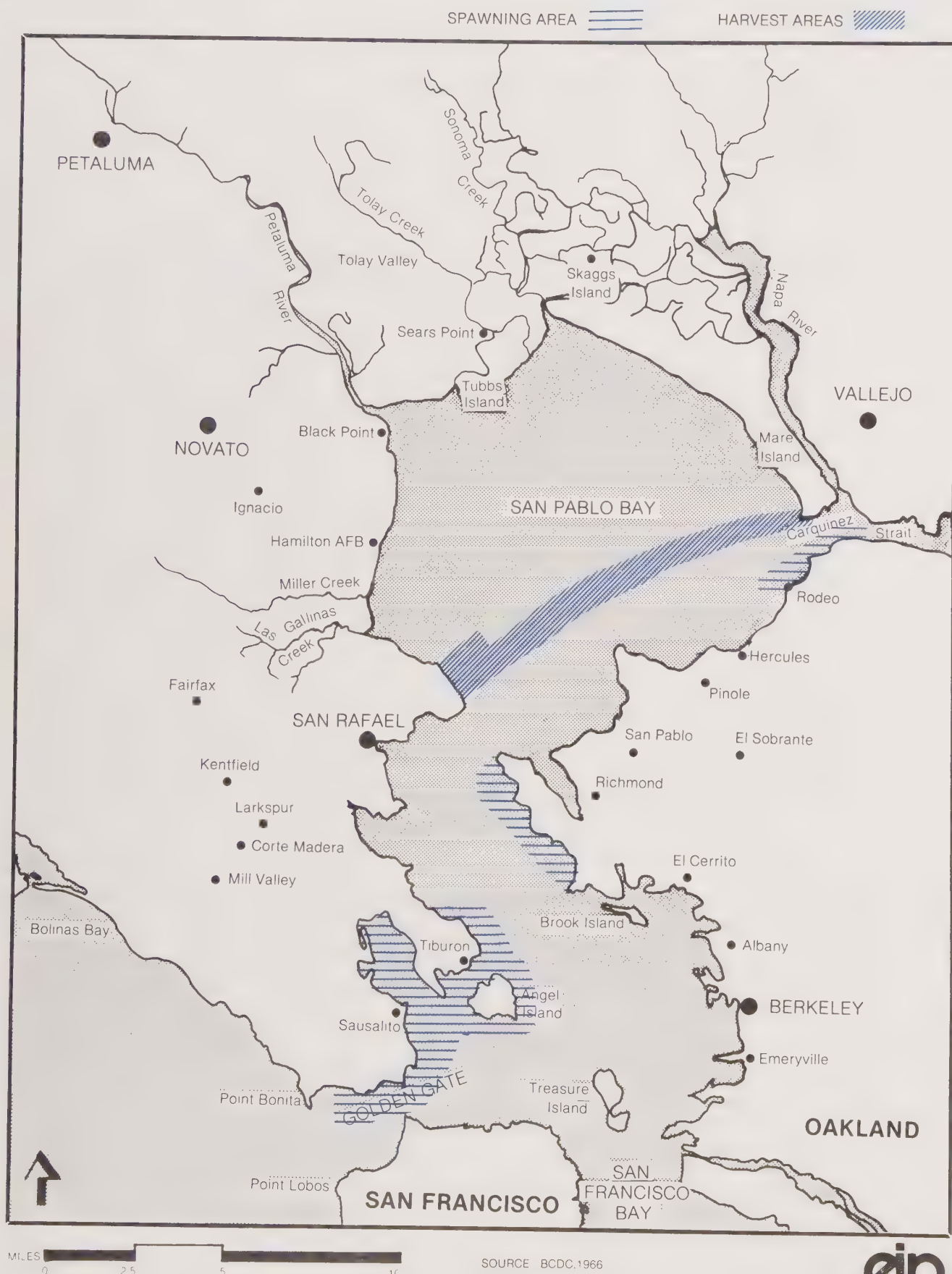
<u>Species</u>	<u>Type</u>
Black perch	Marine
Brown smoothound	Marine
Big skate	Marine
Green Sturgeon	Anadromous
White Sturgeon	Anadromous
American Shad	Anadromous (Introduced)
Pacific herring	Marine
Northern Anchovy	Marine
King Salmon	Anadromous
Steelhead Rainbow Trout	Anadromous
Sacramento Smelt	Marine-Euryhaline <sup>2</sup>
Splittail	Fresh water
Pacific Tomcod	Marine
Striped Bass	Anadromous (Introduced)
White Croaker	Marine
Shiner Perch	Marine
Gobies	Marine-Euryhaline
Brown Rockfish	Marine
Lingcod	Marine
Staghorn Sculpin	Marine-Euryhaline
Jacksmelt	Marine
Topsmelt	Marine
Pacific Sandab	Marine
English Sole	Marine
Starry Flounder	Marine-Euryhaline
Northern Midshipman	Marine
Pile Perch	Marine

<sup>1</sup> 25 or more individuals of a species caught in San Pablo Bay - D.W. Kelley 1966. Ecological Studies of the Sacramento-San Joaquin Estuary.

<sup>2</sup> Euryhaline means adapted to both marine and brackish water environments.

# PACIFIC HERRING SPAWNING AND SHRIMP HARVEST AREAS

FIGURE 6-3



#### 6.2.6 GROUNDWATER IN THE SANTA ROSA PLAIN

Almost all of South-Central Sonoma county is considered to lie within major groundwater basins, notably the Santa Rosa Valley and Petaluma Valley, or within contiguous and detached groundwater areas.<sup>13</sup> The latter areas include almost all the upland areas of South-Central Sonoma County, and encompass geologic units ranging from the high-yielding sandstones of the Merced Formation to relatively poor water-bearing Petaluma beds.

The major water-yielding units in the Santa Rosa Valley groundwater basin are the alluvial fan deposits and the Merced Formation, which occurs below the valley at depths of 200 to 600 feet. The groundwater basin is extensively compartmentalized because of the discontinuous nature of most of the deposits, and because of folding and faulting which disrupt groundwater flow. This compartmentalization, with both vertical and horizontal barriers, results in a variety of groundwater level conditions and a complicated pattern of groundwater quality. Division of the groundwater basin into semi-isolated units also implies that groundwater quality problems will tend to remain localized, barring any substantial changes in pumpage patterns.<sup>14</sup>

Recharge of groundwater areas occurs through percolation of rainfall and seepage from streams, primarily where land slopes are relatively gentle, and soils and geologic materials are permeable. The most significant recharge areas of South-Central Sonoma County, shown in Figure 6-4, include stream channel deposits, alluvial fan deposits, selected areas of alluvium, and much of the outcrop area of the Merced formation. Because these areas are permeable and have high recharge rates, they are consequently more susceptible to contamination from surface sources.

From recharge areas, groundwater in the study area tends to flow toward streams or the troughs of the major valleys. Groundwater discharge occurs primarily through seepage to streams, marshes and San Francisco Bay, or through pumpage of wells. Major pumping depressions occur to the northwest of the City of Petaluma, and along the axis of the Santa Rosa Plain.

# NATURAL RECHARGE AREAS OF SOUTH-CENTRAL SONOMA COUNTY

FIGURE 6-4



SOURCE: BASE MAP BY SONOMA COUNTY PLANNING DEPARTMENT

Groundwater levels and depth to groundwater differ considerably across the study area, reflecting the variety of water-bearing formations and the compartmentalization of the major basins. Depths of water table in the Merced Formation are generally related to topography, with depths to water of several tens to 100 feet under ridges and depths to water of only a few feet in valley areas.

In the Santa Rosa Valleys, shallow groundwater generally occurs at depths of 15 to 35 feet, with higher levels during the winter and early spring.

Generally high groundwater levels in the Santa Rosa Valley indicate that the groundwater basin is essentially "full." As a consequence, much rainfall and surface water does not percolate to the groundwater, but becomes surface runoff.

Although several tributaries to the Laguna de Santa Rosa cross favorable recharge areas, recharge generally is rejected due to lack of available groundwater storage. Groundwater levels approach the ground surface in the vicinity of the Laguna de Santa Rosa, suggesting that shallow groundwater drains into the Laguna, augmenting its flow.

The alluvial deposits along the Russian River are permeable, implying hydraulic connection between the river and groundwater in the adjacent alluvium. The area along the river above the confluence with Mark West Creek (the outlet of the Santa Rosa Plain) is thought to be an area of significant natural recharge. Recharge occurs where groundwater levels are low relative to the river.

Groundwater quality in South-Central Sonoma County generally is good to excellent, although the groundwater tends to be hard. Chemical characteristics are variable, depending on geologic factors. Of the recent alluvial formations, excellent quality water is usually obtained from channel deposits, alluvium, and alluvial fan deposits, while the Bay muds are characterized by high salt content.

The Merced Formation generally produces high quality water, although problems with high iron and manganese have been reported, as well as high sodium and conductivity for wells tapping basal members of the Merced.

A survey of wells was conducted by the California Department of Water Resources in the 1970s. This survey indicated the existence of thousands of wells in south and central Sonoma County. The relative density of wells is shown in Figure 6-5. Wells in the area include wells for irrigation, domestic, industrial, and municipal supply. Pumpage for irrigation accounts for more quantity of groundwater than the other uses combined. These wells, however, represent numerous individual pumpers distributed throughout the area. Domestic wells are also widely distributed. Many of these wells are relatively shallow; and many of the older shallow wells lack adequate sanitary seals, particularly in the eastern portion of the Santa Rosa Plain. Wells lacking a sanitary seal are subject to contamination from surface sources.

Industrial and municipal wells tend to be clustered in and around the area's cities, in some instances with noticeable effects on water table elevations. The single largest pumper in the area is the City of Rohnert Park, which operates 18 wells located generally to the north and west of the City (Township 6 north, Range 8 west). These wells generally extend to a depth greater than 450 feet, tapping the alluvial fan deposits and Merced Formation; several wells exceed a depth of 1,000 feet.

### **6.3 IMPACTS OF WASTEWATER SYSTEM OPERATION**

#### **6.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS**

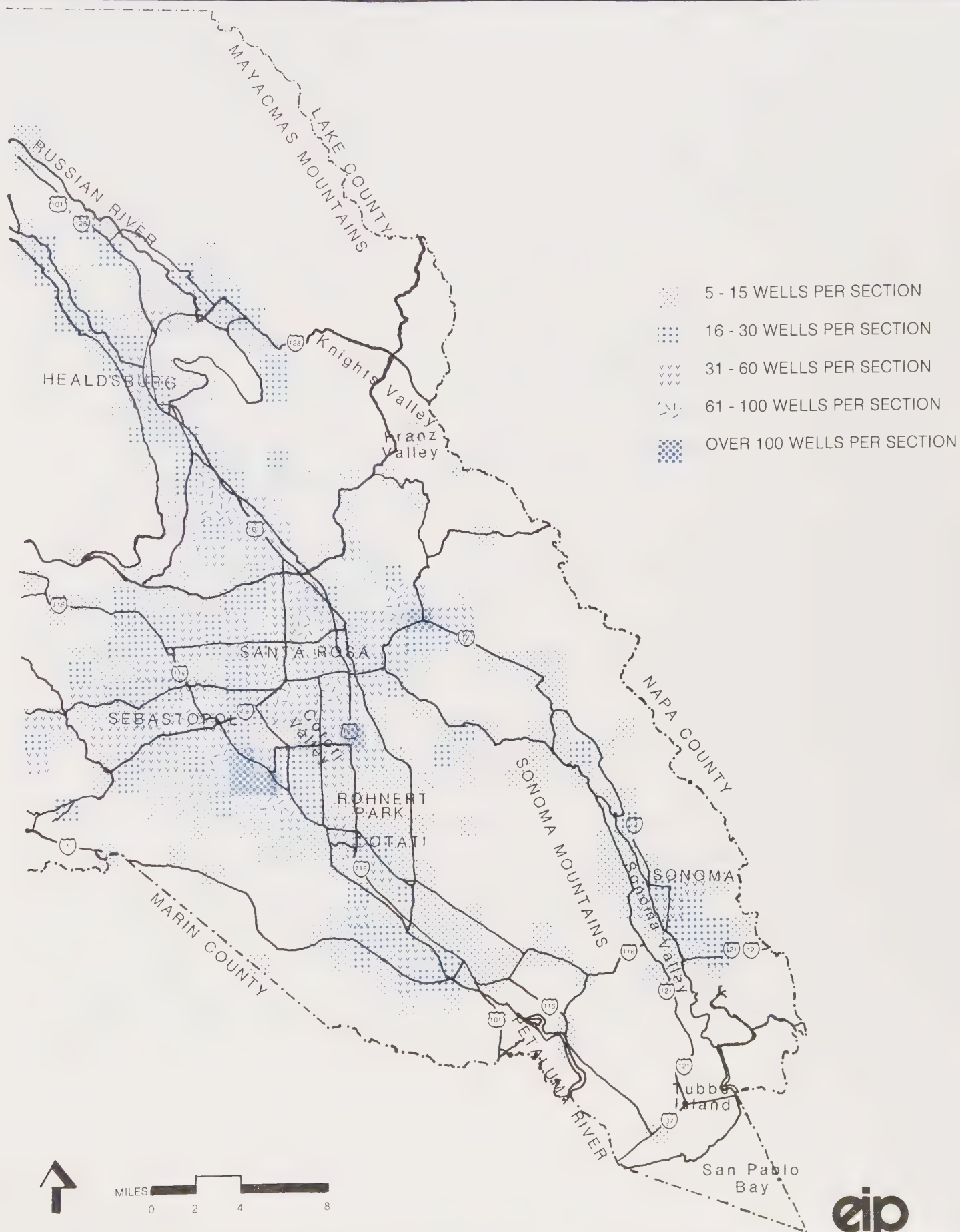
##### Impacts

Possible impacts of operation of the Geysers alternative include groundwater contamination as a result of injection at the geysers, storage of wastewater and wastewater irrigation.

Injection of wastewater into the Geysers would have no significant impact on groundwater resources that can be developed for domestic purposes. The Franciscan Formation typically is not considered to be water-bearing, generally yielding only small amounts of water to wells. Groundwater from the thermal zones typically is highly mineralized and not suitable for domestic, agricultural, or other ordinary uses. Injection of wastewater into thermal zones would result in destruction of any microorganisms and mixing of the wastewater with the poor quality thermal groundwater.

# DENSITY OF WATER WELLS IN SOUTH-CENTRAL SONOMA COUNTY

FIGURE 6-5



Domestic water supplies in the Geysers area are supplied by surface water, or by shallow wells and springs which tap landslide deposits.<sup>15</sup> These deposits, which have a maximum depth of about 150 feet, are characterized by perched water bodies which have no hydraulic connection with deep thermal groundwater resources. The wastewater would be injected to great depths and converted to steam; surplus water condensed in cooling towers is reinjected. Due to the large depths of injection and the low yields in the Franciscan, vertical migration to the surface would be unlikely. Accordingly, the possibility of any adverse impacts of wastewater on developable groundwater resources is remote.

For more than fifteen years, power plant condensate has been reinjected into the steam reservoirs. These waters contain high concentrations of boron, ammonia and bicarbonate. There have been no negative repercussions from this process. This serves as an effective pilot model for the injection of wastewater.

At present, treated wastewater is released from the Laguna treatment plant to the Laguna de Santa Rosa from 15 October to 1 May. Under this alternative wintertime flow would be diverted to the Geysers and thus the discharge to the Laguna would be eliminated. Little information is available on present flow in the Laguna. Although during the wetter months of the winter the wastewater discharge probably only represents a small portion of total flow, during dry months or a dry year it could constitute most of the flow in the Laguna. The reduction in flow at such times, could have an adverse effect on aquatic life and riparian vegetation.

On the other hand, the removal of the wastewater discharge would likely have a beneficial effect on water quality in the Laguna. At present, when dilution is high the present discharge of secondary or advanced treated effluent probably does not significantly affect water quality. However, when dilution is low the ammonia content of the wastewater may have an adverse effect on fish populations, particularly the more sensitive species. Recent studies of the reaction of salmonids to different dilutions of wastewater have been inconclusive, but do suggest that fish may avoid water containing more than 1% treated wastewater.

It is possible that the pipeline conveying treated effluent from the Laguna treatment plant to the steam fields could rupture during an earthquake. A spill of treated wastewater at some point along the pipeline could adversely affect ground or surface water quality and if near a natural stream would likely result in soil erosion and downstream sedimentation. As sediments settle, fish spawning areas could be damaged or destroyed. The pipeline routes to the Geysers cross about 25 creeks.

### Mitigation Measures

The following mitigation measures are suggested:

- o Flow in the Laguna de Santa Rosa near the Laguna plant should be gauged and studies undertaken to determine the effect of discharge elimination on flow. If the effect is sufficient to endanger fish or other aquatic life, then continued discharge of appropriately treated wastewater during low flow periods should be considered.
- o The pipeline should be equipped with appropriate valving and sensing devices to allow rapid shutdown in the event of a rupture. Valves should be located to minimize the volume of spills to natural creeks.

### 6.3.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO THE RUSSIAN RIVER

#### Impacts

Disposal of treated wastewater to the Russian River could affect the quality of river water in ways that might be harmful to aquatic life or recreational users of the river. The potential impacts of river discharge on human health are discussed in Chapter 7. Potential effects on water quality and aquatic life are described below.

As noted earlier, the Regional Water Quality Control Board, North Coast Region has established beneficial uses for the waters of the Russian River. To protect these beneficial uses the basin plan includes a number of discharge prohibitions.<sup>5</sup> Until recently the prohibitions included discharge of wastewater from Santa Rosa to the river between May 15 and September 30 and at all other times when river flow is less than 1,000 cfs as measured at Healdsburg. It was because of this prohibition that Santa Rosa's ability to dispose of wastewater became dependent on the weather.

On June 26, 1986, the portion of the basin plan pertaining to Santa Rosa was modified to allow discharge of advanced treated wastewater at a rate of up to 5% of Russian River flow when storage pond capacity is exceeded, as a result of unfavorable weather.

Although the Board permits discharge of secondary or advanced treated effluent from Santa Rosa to the river during the winter months, it is clear that it views the river discharge as a regrettable necessity to be eliminated, if possible. With reference to coastal streams and natural drainageways that flow directly to the ocean, the basin plan states that "Existing discharges to these waters will be eliminated at the earliest practicable date." Furthermore, in regulating discharges to the Russian River the Board takes account of California Department of Health Services guidelines that state that there should be no direct discharge of sewage effluent to streams used for domestic water supply.<sup>16</sup>

While some confusion surrounds the definition of an "indirect discharge", the fact that the Regional Board tolerates Healdsburg's and other communities' year-round discharge of effluent to the river via percolation ponds suggests that that disposal mode constitutes an indirect discharge.<sup>17</sup> Alternative 2 is conceptually similar to the treatment/disposal systems employed by upstream communities and thus would represent an indirect discharge.

After advanced treatment, wastewater effluent would be conveyed to the rapid infiltration system. Effluent would percolate into the ground, mingle with the underlying groundwater and flow gradually toward the river. Although during dry weather some wastewater might percolate into the deep groundwater, most of it would be expected to enter the river as seepage. Table 6-6 shows the expected quality of effluent after treatment and after passage through the rapid infiltration system. In general, the quality of effluent after passage through the rapid infiltration system would be very similar to that of Russian River water.

During all but very dry years, percolate from the rapid infiltration system would be subject to considerable dilution with groundwater and river water. Table 6-7 shows a conservative estimate of the average dilution with river water that would occur at different times of the year. During the summer months, the volume of treated

TABLE 6-6  
EFFLUENT QUALITY AND RUSSIAN RIVER WATER

<u>Constituent</u>	<u>After Advanced Treatment</u>	<u>After Rapid Infiltration</u>	<u>River Water</u>
Biochemical Oxygen Demand mg/l	<5 <sup>1</sup>	< 1	< 1
Suspended Solids, mg/l	< 5	< 1	varies
Ammonia, mg/l	< 1	< 1	<0.1
Total Nitrogen, mg/l	< 3	< 1	0.1
Total Phosphorus, mg/l	< 2	< 1	< 1
Total Coliform, MPN/100 ml	2.2	< 2.2	+240
Total Dissolved Solids mg/l			

<sup>1</sup>The symbol "<" means "less than".

TABLE 6-7  
SEASONAL VARIATION IN DILUTION WITH RUSSIAN RIVER WATER<sup>1</sup>

	<u>1959-1983</u>	<u>1976-1977</u> <sup>3</sup>
October	9:1 <sup>2</sup>	4:1
November	48:1	4:1
December	123:1	3:1
January	202:1	3:1
February	170:1	2:1
March	125:1	5:1
April	66:1	1:1
May	16:1	1:1
June	7:1	0.5:1
July	5:1	1:1
August	5:1	1:1
September	5:1	1:1

<sup>1</sup> Assumes 25 mgd treated wastewater discharge and average monthly river flow measured at Guerneville. Also assumes all wastewater discharged to rapid infiltration system percolates to the Russian River. During dry periods much of the treated wastewater would be used for irrigation and thus the discharge to the rapid infiltration system would be less than 25mgd. Accordingly the dry year dilution calculation represents a worst case condition.

<sup>2</sup> 9:1 dilution means nine parts river water to one part treated wastewater.

<sup>3</sup> Dryest year of record.

wastewater discharged to the river would vary depending on the demand for irrigation water. It would rarely represent more than 20% of the river flow.

During sustained high flow conditions, that is, when the Russian River flow exceeds 10,000 cubic feet per second for more than one month, groundwater levels below the rapid infiltration system would likely rise to a level which would make the system ineffective. During such times, expected to occur about once in three years, treated wastewater would be released directly to the river or the Laguna. No adverse effects would occur because dilution would be so great.

The basin plan includes a number of numerical water quality objectives designed to protect aquatic life. These standards together with other generally accepted water quality criteria are shown in Table 6-8. It should be noted that the objectives or criteria apply to water in the environment rather than directly to the effluent. Table 6-8 shows the effect of 5:1 dilution; the minimum dilution in a typical year.

Like terrestrial life forms, aquatic life needs oxygen to survive. The water quality objective for Russian River water is 7 mg/l of dissolved oxygen. The dissolved oxygen content of percolate from the rapid infiltration system is difficult to estimate but would probably be in the range of 1 to 4 mg/l. Assuming typical conditions when river water oxygen content and dilution are high, there would be no difficulty in complying with the objective. Even under the worse conditions in a typical year when river flow and dilution are low, the objective would likely be met. Under extreme conditions such as those that occurred during the 1976-77 drought, compliance would be doubtful, but probably equally likely with or without discharge of treated effluent.

Ammonia-nitrogen, a common constituent of wastewater, is toxic to aquatic life. In water ammonia-nitrogen takes two forms, ionized and unionized ammonia. It is the unionized form that is toxic to aquatic life. The proportion of total ammonia-nitrogen that remains unionized depends on water temperature and pH.

The advanced treatment system proposed as part of Alternative 2a.4 would reduce the total ammonia-nitrogen concentration in the effluent to less than 1 mg/l. Passage through the rapid infiltration system would reduce it still further. Under the worse conditions in a typical year, the unionized ammonia concentration after dilution would be less than the generally accepted criterion of 0.02 mg/l.

TABLE 6-8  
TREATED WASTEWATER AND CRITERIA FOR PROTECTION OF AQUATIC LIFE

<u>Constituent</u>	<u>Treated Wastewater Before Dilution</u>	<u>Treated Wastewater After 5:1 Dilution</u>	<u>Water Quality<sup>1</sup> Objective or Criteria</u>
Dissolved Oxygen, mg/l	Unknown <sup>2</sup>	-	Minimum 7.0 <sup>3</sup>
Unionized Ammonia, mg/l	< 0.1	<0.02 <sup>6</sup>	0.02
pH	6.5-8.5	6.5-8.5	6.5-8.5 <sup>3,4</sup>
Total Residual Chlorine, mg/l	0	0	0.002 (salmonids) <sup>4</sup> 0.01 (other organisms)
Nitrate-Nitrogen, mg/l	< 1	<0.20 <sup>5</sup>	0.06 (salmonids) <sup>4</sup> 5.0 (warm water fish)
Temperature	Unknown	-	Maximum 5°F <sup>3</sup> increase over ambient
Arsenic, mg/l	<0.01	<0.002 <sup>6</sup>	0.05 <sup>4</sup>
Cadmium, mg/l	<0.01-0.17	<0.002-0.032 <sup>6</sup>	0.0012 (salmonids) 0.012 (other organisms)
Mercury, mg/l	< 0.002	<0.004 <sup>6</sup>	0.00005

<sup>1</sup> A water quality criterion is a designated concentration of a constituent that, when not exceeded, will protect an organism or a type of water use. It does not have any particular legal standing. A water quality objective is the term used by the State of California to designate a standard that is enforceable under the law.

<sup>2</sup> The dissolved oxygen content of seepage from the rapid infiltration system is difficult to estimate but would probably be less than 5 mg/l.

<sup>3</sup> Water quality objective from Water Quality Control Plan, North Coastal Basin 1B, Regional Water Quality Control Board North Coast Region, 1975.

<sup>4</sup> Water quality criterion from Quality Criteria for Water, U.S. Environmental Protection Agency, 1976.

<sup>5</sup> Assuming background concentration in river water of 0.1 mg/l.

<sup>6</sup> Assuming background concentration in river water of zero.

Nitrate-nitrogen would be reduced by treatment and passage through the rapid infiltration system to less than 1 mg/l. Under the worse conditions in a typical year, river water nitrate-nitrogen concentrations could be increased from the present background level of 0.1 mg/l to 0.25 mg/l. While this would likely have little or no direct effect on higher life forms, it would increase the amount of nutrients available for aquatic plant growth. Some increase in attached algae populations might occur downstream of the discharge during the summer months.

The State's water quality objectives require that water temperature not be elevated more than 5°F above natural conditions. Certain types of fish that inhabit the Russian River are adapted to cold water and cannot survive when water temperature rises. Because the wastewater discharge would enter the river via the groundwater in the form of seepage, its temperature would be lower than that of river water during the summer months.

In general, it appears that implementation of Alternative 2 would allow compliance with water quality objectives and criteria in the Russian River at all times except during severe droughts when it is doubtful that they could be met even in the absence of a treated wastewater discharge.

At present, treated wastewater is discharged to the Laguna de Santa Rosa between 15 October and 1 May. Under this alternative the discharge would be eliminated; the effects of discharge elimination on water flow and quality are discussed in Section 6.3.1.

It is possible that the pipeline conveying treated effluent from the Laguna treatment plant to the rapid infiltration system could rupture during an earthquake. A spill of treated wastewater at some point along the pipeline could adversely affect ground or surface water quality. Because the wastewater would be treated to advanced levels, impacts are not expected to be severe.

### Mitigation Measures

The following mitigation measures are suggested:

- o Storage ponds should be maintained to allow temporary storage of treated wastewater during extremely low Russian River flows and during treatment plant upsets.

- o Routine monitoring of the quality of discharged effluent and the health of aquatic organisms in the vicinity of the discharge should be undertaken. This may be required by the Regional Board as a discharge permit condition.
- o Industrial pretreatment programs in communities that contribute to the Santa Rosa region sewerage system should be implemented aggressively in order to minimize the amount of toxic materials entering the system.
- o Education and other programs should be undertaken to discourage disposal to the sewer of unwanted pesticides and other toxic materials.
- o Flow in the Laguna de Santa Rosa near the Laguna plant should be gauged and studies undertaken to determine the effect of discharge elimination on flow. If the effect is sufficient to endanger fish or other aquatic life, then continued discharge of appropriately treated wastewater during low flow periods should be considered.
- o The pipeline should be equipped with appropriate valving and sensing devices to allow rapid shutdown in the event of a rupture.

### 6.3.3 ALTERNATIVE 3: OCEAN DISPOSAL

#### Impacts

Disposal of treated wastewater to the ocean could affect the quality of ocean waters and sediments in ways that might be harmful to the health of marine organisms or recreational users of nearshore waters. Before describing the impacts that might result from Santa Rosa's discharge, it is worth considering ocean disposal of municipal wastewater in more general terms.

Approximately 9% of the municipal wastewater generated in the United States is discharged directly to the ocean.<sup>18</sup> Prior to the 1950's, most ocean discharges were untreated. Regulatory agencies were concerned only that discharges did not pose a threat to public health. The well-being of marine life was not considered or protected. In the 1950's and 1960's, many coastal communities built primary treatment plants to prevent unsightly pollution of beaches and to protect the health of bathers. The generally accepted view of the sanitary engineering profession, at the time, was that primary treatment, in combination with disposal through a long submarine outfall pipeline was the best method for disposal of municipal wastewater to the ocean.

In 1972, responding to growing public concern about the health of the environment, Congress passed the the Federal Water Pollution Control Act Amendments. The amended Act radically altered wastewater disposal practices in the United States.

One of the Act's provisions was that all municipal wastewater discharges should receive, at least, secondary treatment before discharge to rivers or the ocean. Secondary treatment was required, as a minimum, irrespective of the ultimate disposal site. The legislation did not take account of the fact that some receiving environments, a mountain stream, for example, are less able to assimilate pollutants, without harm, than a large river or the ocean. Legislators believed that it was better to have a law that was simple to administer, because it applied the same standard to all discharges, rather than a more complex law that allowed for variations depending on the nature of the receiving environment.

The requirement that secondary treatment be provided before ocean disposal of wastewater became very controversial. Many experts felt that it was unjustified by scientific fact. The main purpose of secondary treatment is to remove organic matter from the waste stream. This is important before discharge to a river because decaying organic can deplete the oxygen content of the water and in this way destroy or harm aquatic life. Oxygen depletion, as a result of waste discharge, rarely occurs in open ocean waters because of the great dilution available. Although not entirely convinced, Congress recognized that the criticisms had some merit, and so a compromise was included in the Clean Water Act of 1977. Existing ocean dischargers could apply for a waiver of secondary treatment requirements, provided that they could demonstrate that their discharges were not harming the marine environment. On the other hand, new ocean dischargers, and Santa Rosa would fall in this category, would have to provide secondary treatment.

The State of California has approached ocean disposal of wastewater somewhat differently from the federal government. In 1972, the State issued a water quality control plan for ocean waters, usually referred to as the "Ocean Plan". Unlike the federal government, California established a set of standards for ocean discharge based on the, then current, state of scientific knowledge. The standards did not require any particular type of treatment; only that certain environmental quality standards be met. The

standards have been updated as new information has become available. The most recent revision occurred in 1983.

The Ocean Plan standards are designed to protect the quality of ocean waters and the health of the organisms that dwell in it. They emphasize removal, before discharge, of substances thought to be harmful to marine organisms and the rapid mixing or dilution of treated wastewater in the ocean.

To meet both state and federal standards for ocean discharge the Santa Rosa regional system's treated effluent must comply with the effluent limit shown in Table 6-9. The expected quality of the treated effluent is also shown in the table. In addition, the discharge must receive a minimum of 100:1 dilution and not cause toxic materials concentrations in the ocean to exceed the levels shown in Table 6-10. The concentrations of these substances that might be expected in the ocean, near the discharge are also shown assuming that 100:1 dilution is achieved. They are based on analyses of Santa Rosa's treated wastewater made during the last year. The Santa Rosa discharge would comply with the State's requirements in all cases, sometimes by a considerable margin.

The Ocean Plan requires that wastewater discharges receive a minimum of 100:1 initial dilution for two reasons. First, it ensures that the concentrations of any substances in the wastewater diminish very rapidly when the wastewater and ocean water mix; and second it usually prevents the wastewater and ocean water mixture from reaching the ocean surface.

To meet the dilution requirement, the treated effluent would be discharged through a long submarine outfall designed to take advantage of the hydrodynamic characteristics of the disposal site. Although the design of the actual outfall would be based on information obtained from an extensive predischage survey, some assumptions can be made regarding its general characteristics. It is expected that an outfall at either of the two sites under consideration would extend 8,000 to 10,000 feet offshore and would terminate in 80 to 100 feet of water. The portion of the outfall that crosses the beach and the surf zone would be buried to protect it from the effects of breaking waves. The offshore portion of the outfall pipeline would lie on the ocean floor with rocks piled around it to secure it in place. The last several hundred feet of the outfall would comprise the diffuser. The

TABLE 6-9  
EFFLUENT LIMITS FOR DISCHARGE  
TO THE OCEAN FROM SANTA ROSA REGIONAL WASTEWATER SYSTEM

<u>Characteristic</u>	<u>Unit</u>	<u>Limiting Concentration</u> <sup>1</sup>
Biochemical Oxygen Demand	mg/l	30 <sup>2</sup>
Total Suspended Solids	mg/l	30 <sup>2</sup>
Grease and Oil	mg/l	25 <sup>3</sup>
Settleable Solids	mg/l	1.0 <sup>3</sup>
Turbidity	JTU	75 <sup>3</sup>
pH	units	6-9 <sup>3</sup>
Toxicity Concentration <sup>4</sup>	tu	1.5 <sup>3</sup>

<sup>1</sup> Monthly average. Higher concentrations are allowed for weekly average and instantaneous values.

<sup>2</sup> Federal requirement.

<sup>3</sup> State Requirement.

<sup>4</sup> Toxicity concentration is a measure of the gross toxicity of the effluent derived from survival tests of fish subjected to different concentrations of treated effluent.

TABLE 6-10  
CONCENTRATIONS OF TOXIC SUBSTANCES IN OCEAN WATERS,  $\mu\text{g/l}$

Characteristic	Limiting Concentration <sup>1,2</sup>	Background Concentration <sup>1,2</sup>	Predicted Concentration Due to Santa Rosa Discharge <sup>4,5</sup>
Arsenic	8	3	< 0.1 <sup>6</sup>
Cadmium	3	0	0.1-1.7
Chromium (hexavalent)	2	0	< 0.1
Copper	5	2	< 0.42
Lead	8	0	0.1-18.8
Mercury	0.14	0.06	< 0.02
Nickel	20	0	< 0.26
Silver	0.45	0.16	< 0.1
Zinc	20	8	< 0.57
Ammonia-Nitrogen	600	0	0.2
Aldrin & Dieldrin	0.002	0	< 0.002
Chlordane	0.003	0	< 0.001
DDT	0.001	0	< 0.001
Endrin	0.002	0	< 0.001
PCB's	0.003	0	< 0.001
Toxophene	0.007	0	< 0.001

<sup>1</sup>These standards must be met in ocean waters near the discharge after initial dilution is complete. Initial dilution is the dilution that occurs within a few minutes of discharge.

<sup>2</sup>Six-month median concentrations. Higher values are allowed for instantaneous and daily maxima.

<sup>3</sup>Concentration in uncontaminated ocean water.

<sup>4</sup>Assuming that the outfall-diffuser system provides a minimum 100:1 dilution.

<sup>5</sup>The values are based on a single effluent sampling episode in 1986.

<sup>6</sup>The symbol "<" means "less than". It is used when concentrations of a particular substance are below the detection limits of available analytical instruments.

diffuser would have a series of openings or ports through which wastewater would discharge. The diffuser would be oriented perpendicular to the prevailing ocean current direction. Because the prevailing current direction is likely to be parallel to the shore, the diffuser would probably be perpendicular to the coastline.

Treated wastewater emerging from the diffuser ports would rise rapidly because it would be much less dense than ocean water. The buoyancy of the wastewater plume would induce rapid mixing with the surrounding ocean water. This rapid mixing or dilution that occurs within a minute or two of discharge is referred to as initial dilution. After initial dilution is complete, further dilution or dispersion occurs as ocean currents move the wastewater/ocean water mixture away from the outfall. The rate at which horizontal dispersion occurs depends on the turbulence of the ocean. During calm weather, a further dilution of 4:1 might occur within an hour; this would mean that after one hour the treated wastewater would have been subject to a total dilution of 400:1. During rough weather the corresponding dilution would be 1000:1 or more. At these dilutions, the presence of wastewater in the ocean would be virtually undetectable.<sup>19</sup>

Another consequence of rapid initial dilution would be the submergence of the wastewater/ocean water plume under most conditions. During all but a few months each year the waters of the California coast become stratified. Surface waters are heated by the sun and become less dense. Waters below about 30 feet in depth remain cool and dense. The point at which this change in density and water temperature occurs is referred to as the thermocline. When wastewaters emerge from a diffuser they mix rapidly with the dense bottom waters. The wastewater/ocean water plume rises until its density is equal to that of the surrounding water, usually just below the thermocline. The plume is thus trapped below the warmer, less dense surface waters.

Plume submergence was believed to be an important design criterion for marine wastewater disposal at one time, because surfacing plumes of partially-treated sewage could cause a slight change in the appearance of the water surface.<sup>20</sup> It is much less important in the case of discharges of secondary effluent. It is expected that a Santa Rosa discharge would not be visually detectable, even if the wastewater/ocean water plume surfaced.

Considerable effort has been made to study the effects of existing municipal wastewater discharges on the marine environment. The studies undertaken by the Southern California Coastal Water Research Project (SCCWRP) in the Southern California Bight represent the single most extensive body of scientific information on the subject. SCCWRP's results have, however, proved to be controversial. In general, the studies have shown that the large wastewater discharges from Southern California communities have not had gross adverse effects on the marine environment, although there have been measurable changes in the characteristics of the environment within a few miles of the discharge points. Organic material has accumulated on the sea bottom close to the outfalls and some species of bottom fish caught in the vicinity of the outfalls have exhibited a high-incidence of disease.

It should be noted that these adverse effects were produced over many years by discharges of primary effluent in quantities 20 to 40 times greater than the Santa Rosa discharge. In one case, a community discharged both primary effluent and wastewater sludge to the ocean. Because of differences in treatment level and scale of discharge, SCCWRP'S results are not particularly relevant to Santa Rosa, other than to demonstrate that even huge discharges of sometimes poorly-treated effluent have not produced widespread adverse effects.

There are few examples of studies of wastewater discharges similar to the discharge being considered for the Santa Rosa region. The Monterey Peninsula Water Pollution Control Agency constructed a 10,000-foot long outfall near the mouth of the Salinas River in 1983. A mixture of primary and secondary effluent is discharged through the outfall to the deep waters of Monterey Bay. A report was recently published on the results of the first year of postdischarge monitoring.<sup>21</sup> The report compares the condition of the marine environment near the outfall after several years of discharge, with the condition before discharge began. No significant changes were noted in the physical and chemical characteristics of bottom sediments, bottom-dwelling organisms or the concentrations of chemicals in animal tissues. There were, however, dramatic changes in the types of animals found in the immediate vicinity of the outfall as organisms adapted to rocky reefs have colonized the outfall structure. Similar effects have been observed around other man-made or natural reefs, where there is no wastewater discharge.

In summary, California's standards for discharges to the ocean are based on the current state of scientific knowledge about the effects of various substances on water quality and aquatic life. The standards were developed using the results of laboratory tests in which marine organisms are exposed to different concentrations of substances commonly found in wastewaters. The behavior of the organisms is monitored and a concentration determined at which there appears to be an adverse effect on the health of the organism. A factor of safety is then applied to the concentration and a standard established for the substance. Because the proposed Santa Rosa Region's discharge would comply with the State's standards it is very unlikely that it would have a significant adverse effect on water quality or aquatic life.

This does not mean that there is no possibility that adverse effects could occur; only that the risk is very low. Twenty years ago, when regulation of ocean discharges was much less sophisticated than it is today, a discharge from a DDT manufacturer in the Los Angeles area is thought to have contributed to the reproductive failure of the California Brown Pelican. At that time the effects on wildlife of pesticides that persist in the environment were poorly understood. Although there is now a better understanding of the relationship between waste discharge and the health of marine organisms it is still imperfect. Subtle adverse effects, presently unsuspected or undetected, remain a possibility. Vigilant monitoring is the means by which adverse effects can be detected and appropriate action taken.

It has been suggested that introduction of a municipal wastewater discharge to the Sonoma Coast would make the area no longer suitable for marine research by students and faculty at the Bodega Marine Laboratory. There is no reason to believe this would be true as other similar institutions (Moss Landing Marine Laboratory, for example) appear to function successfully in the vicinity of wastewater discharges.

Perhaps more questionable would be the continued use of Bodega Head as a control station for the State's Mussel Watch Program. The Mussel Watch Program is part of the State's program to monitor the quality of California coastal waters. Like many shellfish, mussels are filter feeders, that is, they pump large quantities of water through their bodies in order to filter out and consume small particles of food. Because of this characteristic they tend to accumulate toxic materials in their tissue and thus serve as indicators of water quality. The quality of mussel tissue obtained from different parts of the State is

compared to that of mussel tissue obtained from unpolluted locations known as control stations. Bodega Head is one of two control stations in the State.

Location of a wastewater discharge near the mouth of the Russian River would probably not affect water quality at Bodega Head any more than it is already affected by substances discharged into the ocean by the Russian River, itself. The Russian River flow currently includes treated municipal wastewater flow from the Santa Rosa region and other communities together with urban and agricultural runoff. In this case the Mussel Watch Control Station would be no less suitable than it is today. A wastewater discharge near the mouth of Salmon Creek would not measurably affect water quality at Bodega Head, but it could conceivably influence conditions in some way, making it a less suitable location for a control station.

At present, treated wastewater is discharged to the Laguna de Santa Rosa between 15 October and 1 May. Under the ocean disposal alternative, the discharge would be eliminated; the effects of discharge elimination on water flow and quality are discussed in Section 6.3.1.

It is possible that the pipeline conveying treated effluent from the Laguna treatment plant to the ocean outfall could rupture during an earthquake. A spill of treated wastewater at some point along the pipeline could adversely affect ground or surface water quality and aquatic life. Because the wastewater would be treated, and if appropriate mitigation measures are taken, small in volume, impacts are not expected to be severe.

Because the ocean outfall would cross the San Andreas fault, it would be particularly vulnerable to earthquake damage. In a major earthquake, the outfall would likely rupture at the point where it crosses the fault zone. Treated wastewater would probably discharge through the ruptured pipe several thousand feet from shore. Provided the treatment plant remained in operation, no serious environmental impacts would occur although the reduced dilution might make it impossible to continue meeting all of the Ocean Plan requirements.

### Mitigation Measures

The following mitigation measures are suggested:

- o Predesign oceanographic and biological studies that would obtain data needed to ensure that the outfall is located remote from sensitive habitats and maximizes rapid dispersion of effluent should be undertaken. This would likely be required by the Regional Board.
- o During the period in which the design studies are conducted, additional monitoring of the quality of existing Santa Rosa effluent should be undertaken to ensure that it can meet Ocean Plan standards for toxic materials without additional treatment.
- o Routine monitoring of the quality of discharged effluent and the health of aquatic organisms in the vicinity of the discharge should be undertaken. This would likely be a condition of the discharge permit issued by the Regional Board.
- o Industrial pretreatment programs in communities that contribute to the Santa Rosa region sewerage system should be implemented aggressively in order to minimize the amount of toxic materials entering the system.
- o Education and other programs should be undertaken to discourage disposal to the sewer of unwanted pesticides and other toxic materials.
- o Flow to the Laguna de Santa Rosa near the Laguna plant should be gauged and studies undertaken to determine the effect of discharge elimination on flow. If the effect is sufficient to endanger fish or other aquatic life, then continued discharge of appropriately treated wastewater during low flow periods should be considered.
- o The submarine outfall should be designed to accommodate minor movements on the San Andreas fault without rupturing.
- o The pipeline should be equipped with appropriate valving and sensing devices to allow rapid shutdown in the event of a rupture. Valves should be located to minimize the volume of spills to natural streams.

### 6.3.4 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

#### Impacts

Disposal of treated wastewater to San Pablo Bay could adversely affect water quality in the Bay and the health of organisms that dwell in it. This alternative includes two disposal options; direct discharge to deep waters in the center of the Bay and discharge to deep waters after passage through a man-made marsh. Before describing the impacts that might result from wastewater systems employing the two disposal modes, it is worth considering discharge of wastewater to the Bay, in more general terms.

As the population of Bay Area communities grew in the early part of this century, the Bay became increasingly polluted. Untreated discharges of sewage are thought to have caused

the gradual demise of the, once flourishing, commercial shell fishery. By 1940, the East Bay shoreline was so contaminated with sewage that it had become offensive to eye and nose. Since that time billions of dollars have been spent to eliminate the more obvious adverse consequences of wastewater discharge. Although conditions in the Bay have improved greatly, there is evidence that some less obvious problems remain. Examples are the decline of the striped bass and the high levels of toxic substances found in sediments and organisms taken from certain parts of the Bay.

Unlike the earlier gross water pollution, that could clearly be attributed to inadequately treated municipal and industrial wastewater discharges, the cause of the current problems are uncertain. Possibilities other than municipal and industrial discharges are runoff of pollutants from city streets during storms, fallout of air pollutants and reductions in freshwater flow from the Delta.

Experts and interested laypersons continue to disagree about the overall state of the Bay and the significance and causes of its current problems. Some believe that municipal and industrial dischargers are now so rigorously controlled that they are no longer a significant source of pollution; any remaining problems are caused by other factors. Others believe that municipal and industrial discharges are significant pollutant sources and should be subject to further regulation.

As noted earlier the agency responsible for regulating water quality in San Pablo Bay is the Regional Water Quality Control Board, San Francisco Bay Region. The Regional Board's water quality or basin plan describes how satisfactory water quality will be maintained. The basin plan lists the beneficial uses of San Pablo Bay and establishes water quality standards or objectives that must be met so that beneficial uses are not impaired. To ensure that water quality objectives are complied with the Regional Board imposes effluent limits and other requirements on municipal and industrial discharges to San Pablo Bay.

A discharge from the Santa Rosa regional wastewater system would differ from the existing discharges to San Pablo Bay in that it would represent a transfer from another watershed or basin. Perhaps for this reason the Regional Board has adopted a resolution which would effectively preclude a Santa Rosa discharge. The resolution requires the

conduct of unprecedented studies before a discharge would be permitted and the provision of a redundant or "back-up" disposal system. The City of Santa Rosa is appealing the resolution to the State Water Resources Control Board.

Much of the recent controversy surrounding the health of the Bay has focused on toxic substances and their effects. In an effort to quiet the controversy, the Regional Water Quality Control Board is currently holding public hearings on a number of proposed amendments to the basin plan which would make regulation of toxic substances in wastewater discharges to San Francisco Bay more stringent.

The effluent limits that a discharge from the Santa Rosa region would have to meet are shown in Tables 6-11 and 6-12. While compliance with the effluent limits shown in Table 6-11 is mandatory, exceptions are permitted with respect to the toxic substances limits shown in Table 6-12. If a discharger can demonstrate that all reasonable efforts are being made to control toxic materials, then discharge of concentrations higher than those in Table 6-12 may be permitted. In addition to the effluent limitations discussed above, the discharge would have to receive a minimum 10:1 dilution in the receiving waters.

The expected concentration of various substances in the Santa Rosa region's treated effluent are shown in Tables 6-11 and 6-12. The quality of the effluent would probably be somewhat higher after passage through a freshwater marsh. The discharge would be expected to have no gross adverse effect on water quality or aquatic life. If as some hypothesize, municipal wastewater discharges are one of the causes of a more subtle degradation of the Bay, then the Santa Rosa discharge would contribute to the deleterious effect.

At present, treated wastewater is discharged to the Laguna de Santa Rosa between 15 October and 1 May. Under this alternatives the discharge would be eliminated; the effects of discharge elimination on water flow and quality are discussed in Section 6.3.1.

It is possible that the pipeline conveying treated effluent from the Laguna treatment plant to San Pablo Bay could rupture during an earthquake. A spill of treated wastewater at some point along the pipeline could adversely affect ground or surface water quality.

Because the wastewater would be treated, and if appropriate mitigation measures are taken, small in volume, impacts are not expected to be severe.

### Mitigation Measures

The following mitigation measures are suggested:

- o Routine monitoring of the quality of discharged effluent and the health of aquatic organisms in the vicinity of the discharge should be undertaken.
- o The City should join the Bay Area Dischargers Association and participate in research on the effects of waste discharge on San Francisco Bay.
- o Industrial pretreatment programs in communities that contribute to the Santa Rosa region sewerage system should be implemented aggressively to minimize entry of toxic materials into the sewer system.
- o Education and other programs to discourage disposal to the sewer of unwanted pesticides and other toxic materials should be undertaken.
- o Flow in the Laguna de Santa Rosa near the Laguna plant should be gauged and studies undertaken to determine the effect of discharge elimination on flow. If the effect is sufficient to endanger fish and other aquatic life, then continued discharge of appropriately treated wastewater during low flow periods should be considered.
- o The pipeline should be equipped with appropriate valving and sending devices to allow rapid shutdown in the event of a rupture.

### **6.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION**

Construction of all four wastewater management system alternatives could adversely affect water quality if eroded soil is washed into nearby waterways. The affect on water quality would be a temporarily increase water turbidity. Fish spawning areas could be damaged by silt blanketing gravel substrates. A number of mitigation measures are suggested below. Additional mitigation measures are contained in Chapter 9, Geology and Soils.

- o All construction sites within the banks of a natural creek should be reviewed by the California Department of Fish and Game under a Section 1603 agreement.
- o Construction in the near vicinity of natural creeks should be done in the dry season.
- o A minimum of native vegetation should be cleared within the banks of a creek, and all cleared areas should be revegetated or stabilized as soon as possible.

TABLE 6-11  
GENERAL EFFLUENT LIMITS FOR DISCHARGE TO SAN PABLO BAY

<u>Constituent</u>	<u>Unit</u>	<u>Limit</u>	<u>Predicted Concentration in Santa Rosa Wastewater</u>
Biochemical Oxygen Demand	mg/l	30 <sup>1</sup>	< 30
Suspended Solids	mg/l	30 <sup>1</sup>	< 30
Coliform Organisms	MPN/100 ml	240 <sup>2</sup>	< 23
Oil and Grease	mg/l	10 <sup>1</sup>	< 10
pH	Units	6-9	6-9
Residual Chlorine	mg/l	0	0

<sup>1</sup> Monthly average.

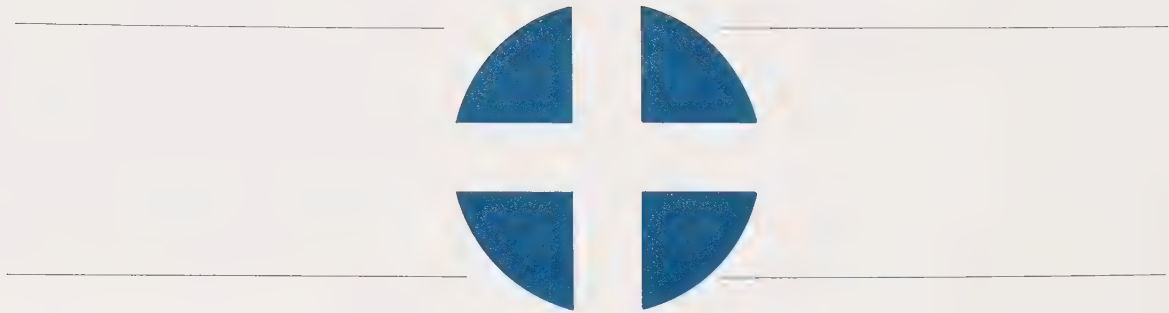
<sup>2</sup> Median value of five samples assuming that the discharge is subject to a minimum of 10:1 dilution in the receiving water.

TABLE 6-12  
TOXIC MATERIAL EFFLUENT LIMITATIONS  
FOR DISCHARGE TO SAN FRANCISCO BAY

<u>Constituent</u>	<u>Unit</u>	<u>Limiting Concentration</u>	<u>Predicted Concentration in Santa Rosa Wastewater</u>
Arsenic	mg/l	0.01	< 0.01
Cadmium	mg/l	0.02	0.01-0.17
Total Chromium	mg/l	0.005	< 0.01
Copper	mg/l	0.2	NA
Lead	mg/l	0.1	0.01-1.88
Mercury	mg/l	0.001	< 0.002
Nickel	mg/l	0.1	NA
Silver	mg/l	0.02	NA
Zinc	mg/l	0.3	NA
Cyanide	mg/l	0.3	NA
Phenolic Compounds	mg/l	0.5	NA
Total Identifiable Chlorinated HydroCarbons	mg/l	0.002	NA

- <sup>1</sup> Russian River Water Plan, Sonoma County Water Agency, 1980.
- <sup>2</sup> Calculated from Pacific Gas and Electric's average annual electrical generation at the Potter Valley Powerhouse.
- <sup>3</sup> Final Environmental Impact Statement: Warm Springs Dam and Sonoma Project, U.S. Army Corps of Engineers, 1973.
- <sup>4</sup> A Water Quality Study of the Russian River Basin during Low Flow Seasons, 1973 to 1978 Sonoma and Mendocino Counties, California, Water U.S. Geological Survey Resources Investigation Report 83-4174, 1984.
- <sup>5</sup> Water Quality Control Plan for North Coastal Basin 1B, California Regional Water Quality Control Board, North Coast Region, 1975 and 1983.
- <sup>6</sup> Progress Report on Russian River Monitoring Special Study, Ronald L. Church, California Regional Water Quality Control Board, North Coast Region, 1986.
- <sup>7</sup> Water Quality Control Plan for Ocean Waters of California, California State Water Resources Control board, 1983.
- <sup>8</sup> Resources Inventory of the Bodega Head ABS, California State Water Resources Control Board, June 1979.
- <sup>9</sup> A Survey of the Marine Environment From Fort Ross, Sonoma Co. to Point Lobos, Monterey Co., California Department of Fish and Game, San Francisco Bay-Delta Water Quality Control Program. 1968
- <sup>10</sup> An interesting article summarizing what is known about the changes that have taken place in San Francisco Bay can be found in the February 7, 1986 issue of SCIENCE, a publication of the American Association for the Advancement of Science. The article is entitled "Modification of an Estuary," by F.R. Nichols, J.E. Cloern, S.M. Luoma and D.L. Peterson, all of whom are research scientists at the U.S. Geological Survey. Another report, prepared by B.J. Miller for the Bay Area Dischargers Association and entitled "The State of San Francisco Bay" describes what is known and not known about the current health of the Bay and the organisms in it.
- <sup>11</sup> Water Quality Control Plan for the San Francisco Bay Basin, California Regional Water Quality Control Board, San Francisco Bay Region, 1975 and 1982.

- <sup>12</sup>Ecological Studies of the Sacramento-San Joaquin Delta, Fish Bulletin 136, California Department of Fish and Game, 1966.
- <sup>13</sup>Evaluation of Groundwater Resources, Sonoma County, Volume I Geologic and Hydrologic Data, Bulletin 118-4, California Department of Water Resources, 1975.
- <sup>14</sup>Evaluation of Groundwater Resources, Sonoma County, Volume II, Santa Rosa Plain, Bulletin 118-4, California Department of Water Resources, 1982.
- <sup>15</sup>Personal Communication, Ron Chappell, UNOCAL.
- <sup>16</sup>Uniform Guidelines for Sewage Disinfection, California Department of Health Services. Undated.
- <sup>17</sup>The California Department of Health Service guidelines do not define direct or indirect discharge. Definitions provided by Health Department staff for indirect discharge include discharges in which the treated effluent loses its identity as wastewater and cannot be distinguished from receiving water after dilution and discharge through a soil barrier such that the effluent loses its identity as wastewater.
- <sup>18</sup>Ocean Disposal of Municipal Wastewater: Impacts on the Coastal Environment, Massachusetts Institute of Technology, 1983.
- <sup>19</sup>Wastewater at these dilutions would be undetectable by all conventional water quality measurements. The presence of wastewater could be detected if special tracer substances are added. This is sometimes done as an aid to the study of wastewater plumes.
- <sup>20</sup>The surface of the ocean sometimes appears streaky as the effects of wind and tide cause planktonic organisms and debris from human activities to accumulate in bands. The accumulated materials alter the surface tension which in turn changes the way in which light is reflected from the surface. Visible bands result. Oil and grease present in primary-treated wastewater can produce the same effect. Because most of the oil and grease has been removed from secondary effluent, it is much less likely to produce visible bands of "slicks" than primary effluent.
- <sup>21</sup>North Monterey County Regional Outfall Monitoring Report, ABA Consultants, 1985.



# PUBLIC HEALTH & SAFETY



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## **7 PUBLIC HEALTH & SAFETY**

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### **7.1 INTRODUCTION**

The proposed project and its alternatives could affect public health in two ways. Water is drawn from the Russian River below the present, and possible future, disposal point for treated wastewater, and used for drinking water supply. The health of consumers of drinking water obtained in this way could be adversely affected. In addition, the Russian River is a popular recreation area during the summer months. Many visitors use the beaches, swim in the river or otherwise come in to contact with river water. Their health could be adversely affected.

Any activities that have the potential to adversely affect public health are closely regulated by a number of government agencies. Key agencies are the Sonoma County Department of Environmental Health, the California Department of Health Services and the Regional Water Quality Control Board. The Regional Board is directly responsible for regulating wastewater disposal and issuing discharge permits. The two health agencies review discharge permit conditions to ensure that public health is protected. The health agencies are directly responsible for regulating the quality of water supplied by public water systems.

### **7.2 SETTING**

#### **DRINKING WATER AND HEALTH**

A number of communities obtain their drinking water supplies from the Russian River, downstream of Santa Rosa's wastewater discharge. Sonoma County Water Agency obtains its water from the river at two locations, the Wohler and Mirabel intakes. Both intakes consist of several wells that extract water from the river gravels. The water extracted is subject to some natural filtration as it passes through the ground, but its quality is very

similar to that of river water. The Wohler intake is located just upstream of the confluence of the Russian River and Mark West Creek and is, consequently, unaffected by Santa Rosa's present discharge. The Mirabel intake is located just downstream of the confluence. Water from the two intakes is blended and disinfected before delivery to the water agencies' customers.

Sonoma County Water Agency supplies the Cities of Forestville and Santa Rosa with essentially all their water. Other communities that obtain some of their water from Sonoma County Water Agency include the Cities of Sonoma, Rohnert Park, Cotati and Petaluma, North Marin County Water District and the Valley of the Moon area.

A number of downstream communities also obtain water from the river via wells in the river gravels. Water is supplied to these communities by several, small, private water companies including the Russian River Terrace Company, the Redwood Water Company, the Citizens Utility Company, Rio Dell Water Company, Hacienda Water Company and Bohemian Grove Water Company. Water treatment is limited to disinfection.

Sonoma County Water Agency supplies about 200,000 customers with all or part of their water from the Russian River. The downstream water companies supply Russian River water to approximately 10,000 customers.<sup>1</sup>

The health of consumers can be injured by microbes or chemicals in their drinking water. A number of bacteria, viruses and parasites, sometimes found in water, can cause disease. The types of pathogenic, or disease-causing, microbes found in a particular water depend on the prevalence of disease in the area. In the United States, where typhoid and cholera are very rare, the organisms of concern are those that cause dysentary, gastroenteritis, infectious hepatitis and giardiasis.

The number of chemicals that might be present in water is almost without end. Many chemicals found in unpolluted fresh waters are derived from natural processes, such as the decay of leaves or other vegetable matter and the erosion of soils and rocks. At the concentrations typically found in natural waters, these chemicals appear to be harmless to man, although our knowledge of their relationship to human health is incomplete. Our knowledge of the health effects of the growing number of organic chemicals created by man is even less complete.

Information on the effects of inorganic chemicals on human health has accumulated over many years. In less enlightened times, industrial workers were often exposed to high concentrations of dangerous chemicals in the workplace. Researchers were able to determine the concentrations at which various chemicals posed a hazard to health. Based on these types of data, health authorities were able to establish standards for drinking water that would protect the health of consumers. The California Department of Health Services has set maximum contaminant levels for inorganic chemicals in drinking water that reflect national standards. They are shown in Table 7-1.<sup>2</sup>

Interest in the health effects of trace amounts of organic matter in water grew in the 1960's and 1970's. This stemmed in part from the development of sophisticated analytical instruments that allowed chemists to detect very minute quantities of chemicals in water. Considerable information has been developed on more than 700 chemicals, some of them suspected carcinogens, that can be found in surface and groundwaters of the United States. Drinking water standards for these chemicals are being developed at present. The California Department of Health Services has established maximum contaminant levels for some of these substances, most of which are pesticides. They are shown in Table 7-1. In addition, they have established "action levels" for about 50 more chemicals. The action levels are concentrations at which the department recommends, but does not require, that a water purveyor take action to improve water quality.

A serious difficulty in establishing chemical drinking water standards arises from the fact that the response to a dose of harmful chemicals may be delayed. There is, of course, little difficulty in establishing a standard for a harmful substance that produces an immediate adverse response. The cause-and-effect relationship is clear. On the other hand, the response to low concentration doses of harmful chemicals may be delayed for many years, in which case, the cause-and-effect relationship is much harder to establish. This is particularly true in regard to cancer and birth defects. Most of our information on cancer-causing substances (carcinogens) and substances that cause birth defects (teratogens) is based on experiments with animals. It is not known whether information from tests in which animals are exposed to very large doses of chemicals are useful in determining whether humans would be adversely affected by very low doses.

TABLE 7-1  
CHEMICALS IN DRINKING WATER (mg/l)

<u>Constituent</u>	<u>Drinking Water Standard</u>	<u>Concentration in Santa Rosa Effluent</u> <sup>1</sup>
Arsenic	0.05	<0.01 <sup>2</sup>
Barium	1.0	0.09
Cadmium	0.01	< 0.01-0.17
Lead	0.05	< 0.01-1.88
Mercury	0.002	<0.002
Selenium	0.01	<0.001
Silver	0.05	<0.01
Endrin	0.0002	<0.0001 <sup>3</sup>
Lindane	0.004	NA
Methoxychlor	0.1	NA
Toxaphene	0.005	<0.0001
2, 4, D	0.1	<0.005
2, 4, 5 TP Silvex	0.01	NA
Trihalomethane	0.1	<0.006 <sup>4</sup>

<sup>1</sup>24-hour composite effluent sample taken 11/26/85.

<sup>2</sup>The symbol < means "less than".

<sup>3</sup>24-hour composite influent sample taken 11/26/85.

<sup>4</sup>Samples taken from ponds January, 1986.

Another, and preferable method, for determining the effect of chemicals on human health, is to compare, over a long period of time, the health of two groups of individuals, one exposed to the chemical in question, the other not exposed. Studies of this type are called epidemiological studies. At present, there is very little epidemiological evidence linking the consumption of water containing trace amounts of synthetic organic chemicals with cancer or birth defects.<sup>3</sup>

## WATER-CONTACT RECREATION AND HEALTH

Swimmers, canoeists and other recreationalists come into contact with Russian River waters, and, no doubt, inadvertently consume small quantities of water. Although accidental consumers of this sort would not be harmed by the chemical quality of river water, they could, at least theoretically, be infected by disease-causing organisms. However, because epidemiological studies do not show a strong relationship between swimming in polluted water and ill-health, infection by this route is probably rare.

The lack of scientific evidence of a connection between swimming in polluted water and disease makes standard setting difficult. Health authorities agree, however, that a bathing water standard of no more than 200 fecal coliform organisms per 100 milliliters of water provides an acceptable level of protection.

## 7.3 IMPACTS OF WASTEWATER SYSTEM OPERATION

### 7.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS

#### Impacts

Alternative 1 involves conveying about 80% of the Santa Rosa regional system's treated effluent to the Geysers for use by the geothermal power plant operators. The remaining effluent would be used for pasture irrigation as it is today. Normal operation of this alternative would have no impact on public health. Treated wastewater would be injected deep into the geothermal strata. Water contained in the geothermal strata is chemically unsuitable for use as drinking water supply. Accordingly, there is no possibility that the injected wastewater could contaminate aquifers that are used for drinking water supply, either now or in the future.

It is possible that the pipeline conveying treated effluent from the Laguna treatment plant to the steam fields could rupture during an earthquake. A spill of treated wastewater at some point along the pipeline could pose a minor threat to public health. The severity of the threat to public health would be limited by the fact that the effluent would be disinfected before entering the pipeline.

### Mitigation Measures

The following mitigation measure is suggested:

- o The pipeline should be equipped with appropriate valving and sensing devices to allow rapid shutdown in the event of a rupture.

### 7.3.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO THE RUSSIAN RIVER

#### Impacts

Indirect discharge of treated wastewater to the Russian River could potentially affect the health of drinking water consumers and bathers. From the point of view of drinking water consumers, the risk of consumption of substances that originated in Santa Rosa's wastewater would depend on the degree of wastewater treatment provided and the dilution that occurs in the river. Alternative 2 would include an advanced wastewater treatment system consisting of conventional secondary treatment with biological nutrient removal, chemically-enhanced sedimentation and filtration. Treated effluent would then enter the river via a rapid infiltration system.

Effluent produced by Alternative 2 would be essentially free of pathogenic organisms, as the effluent is today. The reliability of disinfection would probably be improved, compared to existing conditions, because the increased treatment would produce an effluent containing very low concentrations of suspended solids. The effectiveness of disinfection is thought to be greater when fewer solids are present. Advanced treatment would also remove viruses somewhat more effectively than the existing level of treatment.

A number of other factors influence how implementation of Alternative 2 might effect the bacteriological quality of Russian River water and its suitability as a drinking water source. Although advanced treatment would increase the reliability of disinfection, more

effluent would be discharged to the river than at present. Currently, no discharge occurs during the summer months, and winter discharges are limited to 1% of river flow. Alternative 2 involves year-round discharge to the river. However, it appears likely that the two major changes involved in Alternative 2, better treatment and increased discharge to the river, will not greatly influence bacteriological water quality for two reasons. First, effluent from the Laguna plant is already relatively free of pathogenic organisms, and secondly, Russian River water is subject to bacteriological pollution from other sources.

Studies of the bacteriological quality of the Russian River show that water quality, upstream of the confluence with the Laguna de Santa Rosa, is inferior to that of the present treated effluent, at least, during the winter months.<sup>4</sup> This may be because the river is subject to other wastewater discharges including stormwater runoff from urban areas and illicit discharges from failing septic tank systems. Consequently, it would appear that the bacteriological quality of river water near the downstream water supply intakes is less affected by the Santa Rosa treated wastewater discharge, than by other factors.

Table 7-1 compares the quality of effluent from the Laguna treatment plant with drinking water standards. In most cases, where data is available, the present effluent quality complies with drinking water standards. Exceptions are cadmium and lead concentrations that exhibit occasional elevated levels and nitrate concentrations that are consistently above drinking water standards.

In the future, and assuming implementation of Alternative 2, concentrations of these substances in Santa Rosa wastewater would be expected to decline. The treatment system proposed as part of Alternative 2 would be expected to increase the removal rate of metals relative to the existing treatment system. Further removal of metals would be expected to occur in the rapid infiltration system. Experimental data has shown that almost all the trace metals contained in wastewater applied to rapid infiltration ponds are retained within the first two feet of soil underlying the ponds.<sup>5</sup> In addition, the cities contributing to the Santa Rosa regional system are in the process of implementing a source control program which would reduce or eliminate the discharge of certain substances, cadmium and lead included, to the sewer system.

One element of the treatment system would be biological denitrification. This process would reduce the nitrate content of treated wastewater to about 3 mg/l, much less than the drinking water standard. Further nitrate removal could be expected as a result of passage through the rapid infiltration system.

Because the discharge of treated effluent would continue through the summer when river flow is small, the possibility of treated wastewater entering the downstream drinking water systems would be greater than at present. At present discharge only occurs in the winter months when dilution in the river is high. The quality of the discharge would be much higher, however. In many respects it would be indistinguishable from river water and its consumption would pose a negligible threat to the health of consumers.

### Mitigation Measures

The following mitigation measures are suggested:

- o The bacteriological quality of river water should be monitored upstream and downstream of the rapid infiltration system.
- o Industrial pretreatment programs in communities that contribute to the Santa Rosa regional sewage system should be implemented aggressively in order to minimize the amount of toxic materials entering the system.
- o Education and other programs to discourage disposal to the sewer of unwanted pesticides and other toxic materials should be undertaken.

### 7.3.3 ALTERNATIVE 3: OCEAN DISPOSAL

#### Impact

Disposal of treated wastewater to the ocean could potentially affect the health of swimmers, SCUBA or free divers and other recreational users of nearshore waters. The health of consumers of shellfish harvested from nearshore waters could also be adversely affected.

Swimmers or divers could conceivably be adversely affected if they inadvertently consumed water containing disease-causing organisms. There is little scientific evidence that disease can be transmitted in this way; if it does occur, it is rare. The improbability of infection by this route is further heightened by the fact that effluent would be disinfected and discharged thousands of feet from shore.

The State Water Resources Control Board has established a standard for ocean waters used for body-contact recreation. The standard is not more than 1,000 coliform organisms per 100 milliliters of water. The Santa Rosa regional system's treated and disinfected effluent would contain less coliform organisms than the standard even before dilution with ocean water. Consequently, the body-contact standard would be readily complied with, usually by a wide margin.

Shellfish filter large quantities of water through their bodies in search of food particles. As a result of this feeding method, shellfish tend to concentrate various substances, including bacteria in their tissue. The State Water Resources Control Board has established a standard for the bacteriological quality of ocean waters from which shellfish are harvested for human consumption. The standard is 70 coliform organisms per 100 milliliters of water. Treated and disinfected secondary effluent would likely meet this standard directly. After release through the submarine outfall and dilution in the ocean, the standard would be complied with readily.

Rupture of the pipeline conveying treated wastewater from the Laguna treatment plant to the ocean outfall during an earthquake could pose a minor threat to public health. The threat would not be serious because any spill would be of treated and disinfected effluent.

Because the ocean outfall would cross the San Andreas fault, it would be particularly vulnerable to earthquake damage. In a major earthquake, the outfall would likely rupture at the point where it crosses the fault zone. Treated wastewater would probably discharge through the ruptured pipe several thousand feet from shore. Provided the treatment plant remained in operation, it would be possible to meet the body-contact recreation and shellfish harvesting standards, even with a damaged outfall.

### Mitigation Measures

The following mitigation measures are suggested:

- o Periodic monitoring of bacteriological water quality at the beach and within the surf zone should be undertaken to ensure that standards are met. The monitoring program should include testing of water quality and shellfish tissue from areas in which shellfish are being harvested.

- o The pipeline should be equipped with appropriate valving and sensing devices to allow a rapid shutdown in the event of rupture.

#### 7.3.4 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

##### Impact

Discharge of treated wastewater to San Pablo Bay could potentially affect the health of swimmers, windsurfers or other recreational users of bay waters. The health of consumers of shellfish harvested from the Bay could also be adversely affected.

Two possible disposal methods are being considered for this alternative. One involves discharge through a long submarine outfall terminating in the deepwater channel in the center of the Bay. The other involves a shallow water discharge after passage through a man-made freshwater marsh.

Regardless of the disposal method chosen, treated effluent would be disinfected at the Laguna treatment plant before entering the pipeline conveying it southward. The bacteriological quality of the discharged effluent would be high enough to meet standards for water-contact recreation and shellfish harvesting even without dilution. Taking dilution into account, the standards would be met by a considerable margin.

The pipeline conveying treated effluent from the Laguna treatment plant to the outfall or marsh could pose a minor treat to public health if it ruptured during an earthquake. The threat would not be serious because the spilled effluent would have received secondary treatment including disinfection.

##### Mitigation Measures

The following mitigation measures are suggested:

- o Periodic monitoring of bacteriological water quality should be undertaken to ensure that standards are met. The monitoring program should include testing of water quality and shellfish tissue from areas in which shellfish are being harvested.
- o The pipeline should be equipped with appropriate valving and sensing devices to allow a rapid shutdown in the event of a rupture and spill.

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<sup>1</sup> Don Smith, Sonoma County Department of Public Health and Matt Mullan, Citizens Utility Company.

<sup>2</sup> California State Department of Health Services.

<sup>3</sup> Drinking Water and Health. National Academy of Sciences, 1980.

<sup>4</sup>

<sup>5</sup> Process Design Manual for Land Treatment of Municipal Wastewater, U.S. Environmental Protection Agency, 1981.





VEGETATION  
& TERRESTRIAL  
WILDLIFE



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## 8 VEGETATION AND TERRESTRIAL WILDLIFE

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### 8.1 INTRODUCTION

The setting section of this chapter describes the general vegetation communities and associated wildlife that are known to occur in four separate areas that may be affected by project alternatives; the Laguna de Santa Rosa or Santa Rosa Plain, the coastal margin in Sonoma County west of the Santa Rosa Plain between the mouth of the Russian River and Bodega Head, the Geysers area north of Windsor, and the northwest area of the San Pablo Bay shoreline between Sears Point and Gallinas Creek, Marin County. The discussion focuses on the terrestrial biotic resources along the pipeline routes and other proposed facilities which may be affected by the various project alternatives.

The impact analysis is limited by the lack of specific information on the project construction and location of the proposed facilities. The goal of the impact evaluation is to identify areas of sensitivity so that specific impacts to these sensitive areas can be addressed when specific plans for the proposed project are developed at a future date. Wherever possible, specific project effects are identified.

The goals of the mitigation section are to identify measures that would reduce or eliminate adverse impacts, and to define further studies where specific project impacts cannot be identified.

### 8.2 SETTING

#### 8.2.1 LAGUNA DE SANTA ROSA

##### Vegetation

The dominant native vegetation communities in the Santa Rosa Plain and the Laguna de Santa Rosa are annual grasslands, oak savannah and woodlands, riparian woodlands along

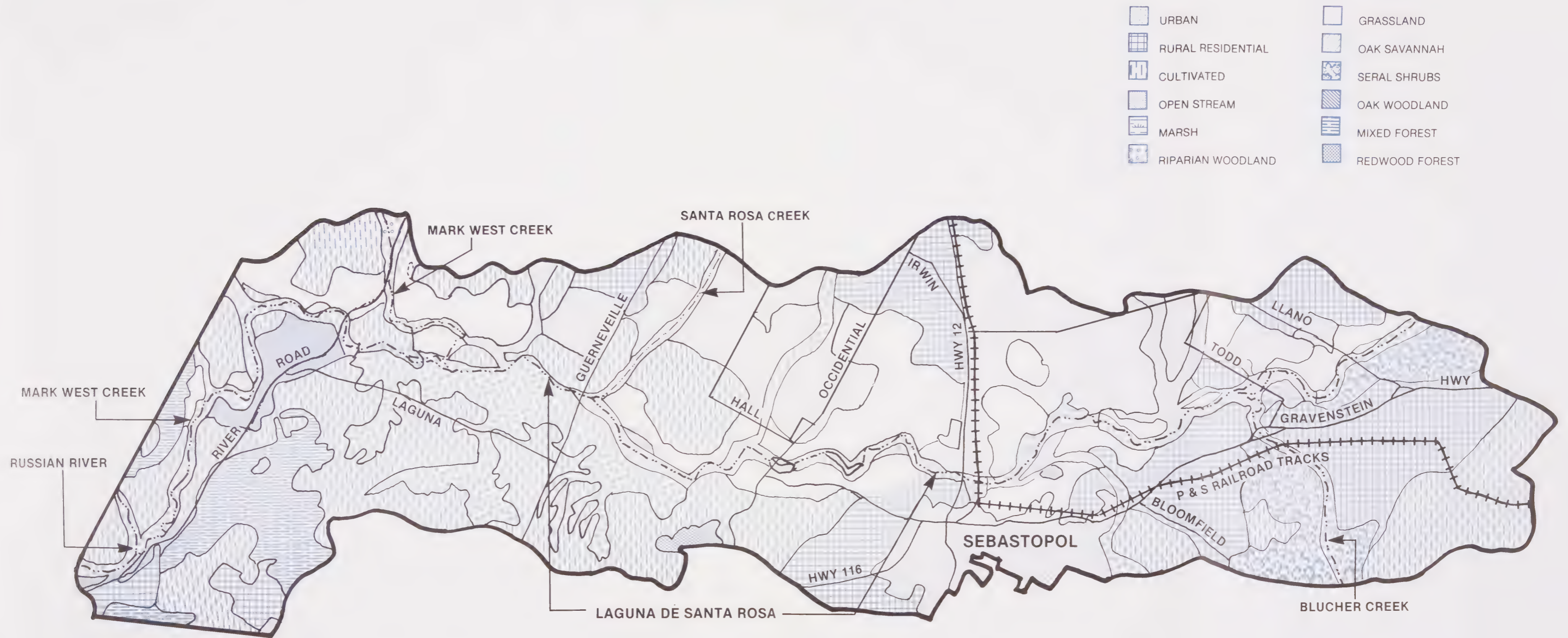
waterways, freshwater marsh within the waterways, and vernal pools within the oak savannah and grasslands. In addition to the native vegetation, there are large areas of urban and rural development, and agricultural fields which have all but eliminated the native vegetation communities. A list of many of the plants found in areas with native vegetation in the Laguna area are presented in Appendix B. A generalized vegetation map of the Laguna de Santa Rosa area from River Road to Stony Point Road is presented in Figure 8-1. A similar map for the area of the proposed rapid infiltration basins is not available at this time, however, undisturbed portions of the area are known to support many of the same communities.

The grassland community is somewhat artificial in that many of the oak trees that once occurred in these areas have been harvested for timber and or cleared for agriculture, and the non-native annual grassland community dominates the open spaces. In other areas, vast stretches of native bunch or perennial grasses have been replaced by the non-native annual grass species which now dominate the existing grasslands. The annual grasses tolerate livestock grazing and harvesting better than the native perennial species and thus the conversion of the native perennial grasslands to annual grasslands has largely been a result of past and current agricultural practices. The conversion of the native plant communities to annual grasslands has been so extensive throughout California that annual grasslands are now considered to be a naturalized plant community in California.

The oak savannah woodlands is essentially a grassland with widely scattered valley oaks (Quercus lobata). On the low foothills the savannah also includes the coast live oak (Q. agrifolia), Oregon white oak (Q. garryana), and occasional black oaks (Q. kelloggii). Oak woodlands have been reduced in extent in California since European colonization in 1770. Some of the major land use practices that have reduced the native oak woodlands include livestock grazing, fuel wood harvesting, agricultural clearing, and urban development. The original oak woodlands of the Santa Rosa Plain ranged in structure from dense stands of trees (greater than 30% canopy cover) along drainage courses and in the higher elevations of the foothills to an open savannah through much of the plain. Past land use practices have limited the extent of the dense woodland communities and favored the savannah community. Examples of a native oak woodland stand and an oak savannah after agricultural clearing are shown in Figure 8-2. In addition to reducing the original extent of the oak woodland community within the Santa Rosa Plain, current grazing and

# VEGETATION COMMUNITIES OF THE LAGUNA DE SANTA ROSA

FIGURE 8-1



SOURCE: LAGUNA DE SANTA ROSA ENVIRONMENTAL ANALYSIS AND MANAGEMENT PLAN





# OAK SAVANNAH WOODLAND

FIGURE 8-2



**A.** Post Agricultural Clearing (With Vernal Pool)



**B.** Pre Agricultural Clearing

**eip**

harvesting practices are preventing the regeneration of oaks and thus preserving the savannah communities. The remaining oaks are of medium to old age (100-400 years), and slowly being eliminated. The oak trees in the effluent spray irrigation lands are also being adversely affected by the irrigation in the summer months. These trees have evolved to survive the Mediterranean climate of California of wet winters and dry summers. Summer irrigation has altered the natural conditions that these trees have evolved in, and as a result various pathogenic root fungi are promoted in the roots of these trees which limits the trees ability to absorb water and nutrients. The trees then become weakened and susceptible to other diseases and eventually die.

Within the oak savannah grasslands are numerous shallow depressions and swales or vernal pools. These depressions support an entirely different annual vegetation type adapted to winter and springtime inundation and summertime dry conditions. A number of the plant species that typically occur in vernal pools are now classified as rare and/or endangered (see discussion below on endangered species). Vernal pools and their associated plant species are classified as rare in California, because many of these unique natural communities are being eliminated by urban development and agricultural practices.<sup>2</sup>

The riparian woodland community is associated with the waterways within the Santa Rosa Plain. These woodlands border the waterways ranging in width from a few feet to hundreds of feet. Past agricultural practices have reduced the riparian vegetation in many areas along the Laguna de Santa Rosa. The woodlands are predominantly composed of willow trees (Salix sp.), Oregon ash (Fraxinus latifolia), box elder (Acer negundo) and various oaks (Quercus sp.), with a dense understory of brush species. These riparian zones are important wildlife areas providing nesting, feeding, and cover habitat for a high diversity of wildlife species.

The freshwater marsh community occurs shallow standing water and saturated soils occur year round. In some areas the vegetation completely chokes the waterway extending from bank to bank. Aquatic plant species, such as pennywort (Hydrocotyle sp.), buttercup (Ranunculus sp.), and pondweed (Potamogeton sp.), dominate in the lower reaches of the Laguna de Santa Rosa. The upper reaches of the Laguna support dense stands of Tule reeds (Scirpus sp.) and cattails (Typha sp.). These marshlands provide important nesting, feeding, and resting areas for waterfowl of the Pacific Flyway. The Laguna is considered

to have the most varied habitat of the largest fresh water marsh systems in the Northern California Coast Ranges.<sup>3</sup> Marshland habitats within the Laguna system range from permanently boggy areas to seasonally wet areas.

### Wildlife

A variety of native wildlife species typical of the habitat types in the Laguna are known to occur in this area. As the native habitats are converted to agricultural lands, the diversity and abundance of these native wildlife species are reduced. Common and typical mammal species known to occur in the area include black-tailed deer, raccoons, skunks, rabbits, and meadow mice.

The diverse plant communities in the Laguna provide a rich habitat for a large number of bird species. The shallow waters of the channel are prime feeding grounds for herons and egrets. The marshes provide important feeding and nesting habitat for species of duck, and other waterfowl. The riparian woodlands provide food, cover, hunting perches, and nesting habitat for a wide variety of bird species. A list of birds sighted in the Laguna region is presented in Appendix B. The riparian community also acts as a link to other native communities. Migratory wildlife use the cover provided by the riparian vegetation to safely move from one community to the next.

### Rare and/or Endangered Species

The rare and/or endangered plant species known to occur in the Laguna de Santa Rosa area are listed in Table 8-1. Most of these plants are vernal pool and freshwater marsh inhabitants. A generalized map of vernal pool areas remaining in the Laguna de Santa Rosa area developed from aerial photographs is presented in Figure 8-3. Other vernal pools and their associated rare plant species may occur in the Laguna but were not detectable on the aerial photographs. Figure 8-3 merely indicates how extensive this habitat is in the Laguna de Santa Rosa. Specific locations of endangered plant species have been mapped, and are maintained by the local chapter of the California Native Plant Society, and the California Department of Fish and Game.<sup>4,5</sup>

There are no rare or endangered mammals, fish or reptiles known to occur in the Laguna de Santa Rosa area. The more significant rare bird species known to occur in the area are listed in Table 8-2.

TABLE 8-1  
RARE AND/OR ENDANGERED PLANT SPECIES OF THE  
LAGUNA DE SANTA ROSA AREA<sup>1</sup>

Common Name (Scientific Name)	Status <sup>2</sup> State/Federal/CNPS	Notes
Sonoma Alopecurus ( <u>Abpercurus Aequalis</u> var. <u>sonomensis</u> )	1C2/List 1B	This annual grass blooms from May-June and is commonly associated with moist places of the Santa Rosa Plain and the coastal region of Marin and Sonoma County.
Rincon Manzanita ( <u>Arctostaphylos stanfordiana</u> ssp. <u>repens</u> )	1/List 1B	This brush species is endemic to Sonoma County and the Russian Ridge east of Santa Rosa.
Clara Hunt's Milk Vetch ( <u>Astragalus clarianus</u> )	1C2/List 1B	This short blooming plant (April-May) is known to occur on grassy slopes in the Mark West region north of Santa Rosa.
Baker's blennosperma ( <u>Blennosperma bakeri</u> )	1C2/List 1B	This annual forb is known to occur in vernal pools near the Santa Rosa Airport immediately west of the site. It blooms from March-April.
White Sedge ( <u>Carex albida</u> )	E/C1/List 1B	This perennial, wetland herb is very rare and now believed to be limited to a single population at the Pitkin Marsh.
Rincon Ridge Ceanothus ( <u>Ceanothus confusus</u> )	1C2/List 1B	This low, prostrate bush is limited in its range to Napa, Lake and Sonoma Counties. It occurs in chaparral brushlands.
Sonoma Ceanothus ( <u>Ceanothus sonomensis</u> )	1/List 1B	This is a very rare brush species which occurs in chaparral in the Hood Mt. Rane of Sonoma County east of Santa Rosa.

TABLE 8-1 continued

Common Name (Scientific Name)	Status <sup>2</sup> State/Federal/CNPS	Notes
Dwarf Downingia ( <u>Downingia humulis</u> )	1/List 4	This annual plant occurs in vernal pools in the Santa Rosa Plain and the Sonoma Valley. It blooms from March to mid-May.
Burke's Goldfields ( <u>Lasthenia burkeii</u> )	E/C2/List 1B	This endangered annual plant occurs in vernal pools and wet meadows from southern Mendocino County to Sonoma County. It blooms from April-May.
Cunningham Marsh Meadowfoly ( <u>Lim??? vincolans</u> )	E/C2/List 1B	This endangered annual plant occurs in vernal pools and wet meadows and is endemic to Sonoma County. It blooms from mid-April to mid-July.
Many Flowered Navarretia ( <u>Navarretia pliea?ha</u> )	E/C2/List 1B	This endangered plant is known to occur in but a few locations in Lake and Sonoma Counties in vernal pools and on the margins of lakes. It blooms from May-June.
Hoover's Semaphore grass ( <u>Pleuropogon hooverianus</u> )	R/C2/List 1B	This rare grass is known to occur in meadow and mixed evergreen forest from Marin to Mendocino Counties.
Kenwood Marsh Checker- ( <del>Silene</del> <u>oregana</u> ssp <u>valida</u> )	E/C2/List 1B	This endangered plant is limited to one known location in a freshwater marsh in Knights Valley in eastern Sonoma County.

<sup>1</sup>Source: Sonoma County Draft General Plan, Environmentally Sensitive Areas, 1986.

<sup>2</sup>State Rare (R), Threatened (T), Endangered (E) - California Endangered Species Act of 1971.

Federal Endangered (E), Threatened (T), Candidate (C1-Taxa for which the U.S. Fish & Wildlife Service has information to support listing, C2 - Taxa for which the service requires further study before listing), Federal Endangered Species Act of 1973.

CNPS (California Native Plant Society, 1984. Inventory of Rare and Endangered Vascular Plants of California.)

List 1B - Plants rare and endangered in California and elsewhere.

List 3 - Plants about which more information is needed.

List 4 - Plants of limited distribution (a watch list).

### 8.2.2 COASTAL AREA

#### Vegetation<sup>6</sup>

This region of Sonoma County contains a large diversity of vegetation communities ranging from the coastal prairie grasslands and scrub along the immediate coastline, the coastal forests extending some ten miles inland in the Mendocino Highlands and the inland grasslands of the Merced Hills south of the coastal forest and east of the coastal prairies.

The vegetation communities immediately along the coast include the rocky coastal bluffs, coastal scrub, coastal prairie, and sand dunes. The coastal bluffs support a unique plant community adapted to the high winds and salt spray environment. These shrub and herbaceous plants typically have a low, compact growth form and succulent to hairy leaves designed to withstand the high winds and relative drought conditions.

The coastal sand dunes occur all along this stretch of coastline however the largest area of these dunes occur at Bodega Head. A smaller dune area occurs at the mouth of the Russian River as well. The vegetation of this community is adapted to the highly unstable environment of the shifting dunes. The coastal dunes may be divided into two dune habitats, the unstable foredunes immediately inland of the sandy beaches, and the more stable backdunes just behind the foredunes. Vegetation on the foredunes is well adapted to surviving the shifting sands and drought conditions. Common species in these dunes are the bush lupin (Lupinus arboreus), and the non-native European beachgrass (Ammophila arenaria), a plant that is considered weedy and invasive. The backdunes support a greater variety of plant species including the sand strawberry (Fragaria chiloensis), sea figs (Mesembryanthemum sp.), and Monterey cypress (Cupressus macrocarpa). In some of the low lying areas between the dunes, the water table intersects with the ground surface creating isolated wetlands within the dune areas.

The coastal prairie grades into the coastal scrub and the inland grasslands and thus is difficult to differentiate at times. As with the interior grasslands, this community is now dominated by non-native annual grasses that have displaced the native bunch grasses. The coastal scrub is interspersed within the coastal prairie. This community of brush species has two forms: a "dry form" consisting of California sagebrush (Artemisia californica), poison oak (Toxicodendron diversilobum), and sticky monkey flower (Mimulus auranticus) on the more exposed slopes and bluffs: a "moist form" composed of various berry plants, ceanothus, and wind pruned Bay trees on north facing slopes and next to riparian vegetation within coastal ravines.

# VERNAL POOL MAP

FIGURE 8-3

VERNAL POOL AREAS

SOURCE: 1980 AERIAL PHOTOS  
SONOMA COUNTY PLANNING DEPARTMENT  
CALIFORNIA NATIVE PLANT SOCIETY

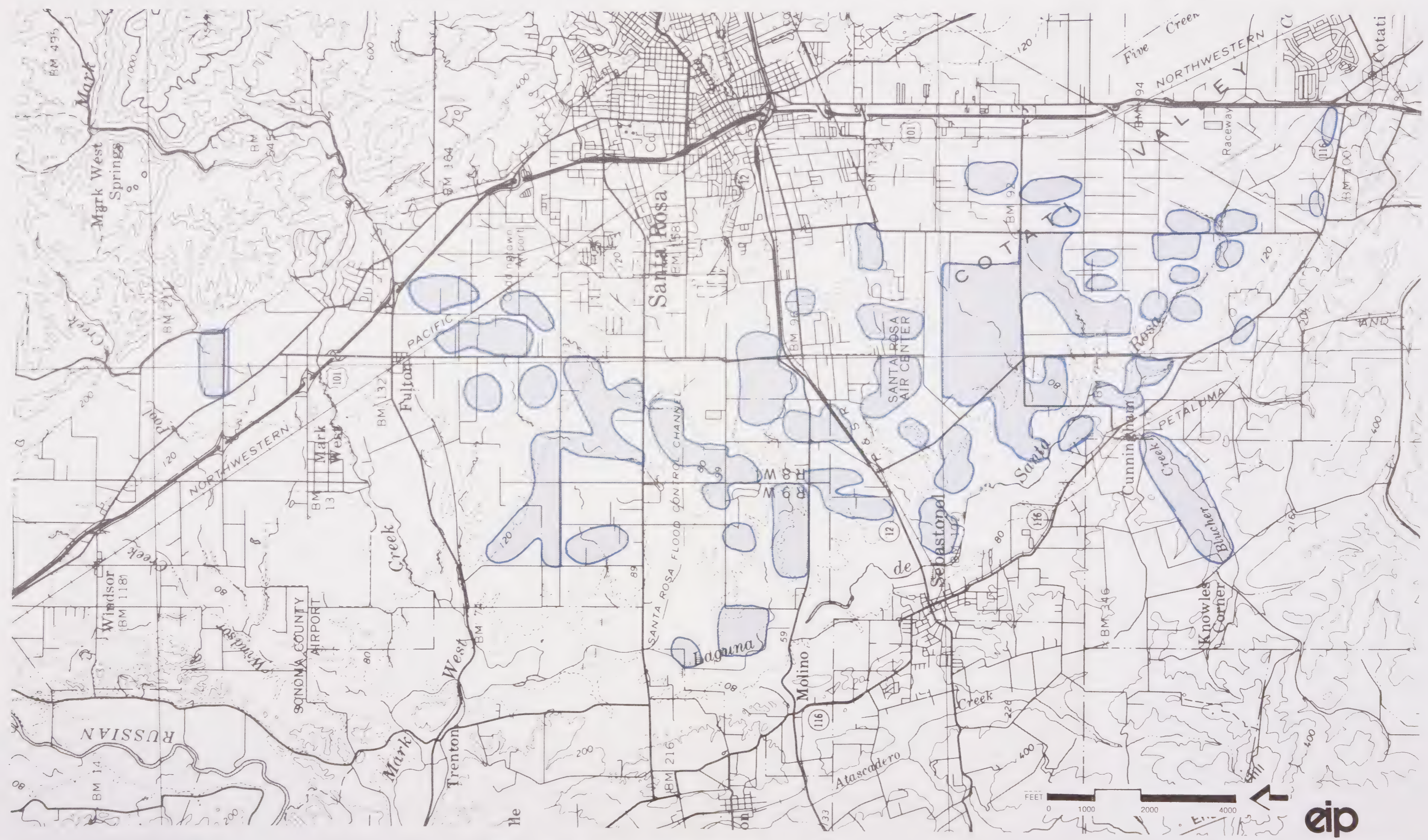




TABLE 8-2  
RARE BIRD SPECIES SIGHTED IN THE  
LAGUNA DE SANTA ROSA AREA

Common Name (Scientific Name)	Status <sup>1</sup> State/Federal/CNPS	Notes
Peregrine falcon ( <u>Falco peregrinus anatum</u> )	E/E/	Although not known to nest in the area, it is known to nest in the surrounding foothills and may hunt in the Laguna de Santa Rosa in early summer months.
Bald eagle ( <u>Haliaeetus leucocephalus</u> )	E/E/EA	Nearest nesting population is located north near Lake Berryessa. Has been sighted on occasion over the Laguna during winter months.
Prairie falcon ( <u>Falco mexicanus</u> )	/ /SS	(See notes on Peregrine falcon.)
Burrowing owl ( <u>Athene cunicularia</u> )	/ /SS	This small owl nests in open grasslands, occupying rodent burrows. Nesting colonies are known to be scattered throughout the Laguna de Santa Rosa area.
Trumpeter swan ( <u>Cygnus buccinator</u> )	/ /SS	This large swan has been sighted in the Laguna as a winter migrant.

<sup>1</sup> State Endangered (E/ /) under the California Endangered Species Act (1984).  
Federal Endangered ( /E/) under the Federal Endangered Species Act of 1973.  
EA = Protected under the Bald Eagle Protection Act (Part II, Title 50), CFR.  
SS = Species of Special Concern to the California Department of Fish & Game.

Immediately east of the coastal scrub and prairie and higher in elevation are the coastal coniferous forests including Bishop Pine (Pinus muricata) Forest, Redwood (Sequoia sempervirens) Forest, and the Douglas-fir (Pseudotsuga menziesii) Forest. The Bishop Pine Forest is typically a mile in width grading into the other coniferous forests. The Redwood forests occur in small pockets on the lower slopes of deep canyons and alluvial bottoms where the coastal fog persists in the summer months. The Douglas-fir Forests occurs on relatively dry sites up slope and inland of the Redwood and Bishop Pine Forests. Many of the associated tree and understory plant species occur in all three of these forests including; Madrone (Arbutus Menziesii), huckleberry (Vaccinium ovatum), and salal (Gaultheria shallon).

The mixed evergreen forest occur east of the coastal coniferous forests to the Green Valley area. This community is characterized by a tree canopy cover of over 50% composed of California bay (Umbellularia californica), tan bark oak (Castinopsis chrysophylla), Madrone, buckeye (Aesculus californica), and bigleaf maple (Acer macrophyllum). The brush understory is typically dense. Scattered within these forests are islands of grasslands and Northern oak woodlands, a community where the dominate tree species are the Oregon white oak and the California black oak.

Two unique and specialized plant communities occur on the serpentine soils in the Harrison Grade-Camp Meeker area, Sargeant Cypress (Cupresses sargentii) Forest and Serpentine Chaparral. Serpentine soils are typically shallow, low in nutrients, and high in manganese. These conditions typically stunt the growth of the plant species occurring on these soils, and may even exclude the growth of some species altogether. A number of rare brush and herbaceous plants are known to occur on these soils including Baker's manzanita (Artostaphylos bakeri) and Hoffman's jewel flower (Streptanthus glandulosus var. hoffmanii).

There are seven significant freshwater marshes in this region; Pitkin Marsh southeast of Forestville, Forestville Marsh south of Forestville, Cunningham Marsh approximately two miles southwest of the Laguna de Santa Rosa treatment plant, Duncans Mills Marsh just north of Duncans Mills, Willow Creek Marsh at the confluence of willow creek and the Russian River, Atascadero Marsh on Atascadero Creek west of Sebastopol, and the Salmon Creek Marsh at the mouth of Salmon Creek.<sup>7</sup> Some of these marsh areas are known to

support a number of rare plant species. A seventh marsh, Perry Marsh, has been so badly disturbed that all of the rare and endangered plant species that once occurred in this marsh are now believed to have been eliminated.

Riparian communities of various extent occur along all of the rivers, creeks, and drainages in this region. These riparian communities range in extent from dense woodlands on the Russian River and its major tributaries to shrubby willows and blackberry thickets along the shallow drainage swales in the Merced Hills. Some of the major riparian corridors in this region occur along Atascadero, Blucher, Green Valley, Jonire, Salmon, and Austin Creeks as well as the Russian River.<sup>7</sup>

### Wildlife<sup>8</sup>

The freshwater marshes and riparian communities provide important habitat for a wide variety of wildlife species. The emergent vegetation in the wettest portions of the marsh provide food and cover for migrating waterfowl species, amphibians, and small reptiles. The surrounding trees and open grasslands on the uplands, provide habitat for small mice, voles, and other small mammals that also serve as a food source for larger predators such as hawks, raccoons, and minks. The riparian woodlands provide cover and nesting habitat for wildlife species that not only reside within the riparian corridor but also for those species in surrounding habitats which utilize the water, food and cover resources within the community.

The coastal bluffs are used as roosting areas by gulls, pelicans, pelagic cormorants and other seabirds. Bobcat are known to feed upon the large populations of brush rabbit within the coastal scrub communities.

The coniferous forests communities support a wildlife community that key in on the vegetation structure, so that many of the same species appear in different forests types. A large variety of bird species occur in these forests utilizing the various levels of vegetation for cover, food, and nesting sites. Of greatest significance in these communities is the spotted owl, a small owl known to exist in old growth forests (100-200 years old) and requires 2,000-3,000 acres of habitat to survive. Large mammals are also known to occur in these woods including fisher, martins, bobcats, blacktailed deer, and even black bear on occasion.

### Rare and Endangered Species

There are a number of rare plant and animal species that are known to occur in this area of the Sonoma County coastline. The California Natural Diversity Data Base (CNDDB) of the California Dept. of Fish and Game, and the California Native Plant Society (CNPS) have mapped all the rare and endangered species known to occur in the area. The rare and endangered species known to occur in this area are listed in Table 8-3. One of the most sensitive areas known to support a number of endangered plant species are the serpentine and peridotite soils. These ultrabasic soils have chemical qualities that are believed to inhibit the growth of many common plant species. Those rare species that have adapted and evolved to survive on these unique soils are able to persist because of reduced competition with the more common species in the surrounding soils. There are no serpentine or peridotite soils known to occur along the proposed pipeline routes to the coast as indicated in Figure 9-3. Other specific habitats known to support rare plant species and or considered rare or of limited extent include; wetlands or marsh areas and coastal sand dunes. The Sonoma County Local Coastal Plan (LCP) identified a number of "Environmentally Sensitive Habitat Areas" in and around the coastal region. These identified areas include freshwater marshes, riparian corridors, heron rookeries and seabird colonies.<sup>9</sup>

The peregrine falcon (*Falco peregrinus*) is the only rare wildlife species suspected of occurring in the study area that is listed by the U.S. Fish & Wildlife Service under the Endangered Species Act of 1973. This bird is believed to once have nested on the isolated cliffs of the offshore rock islands, however, there has not been a recent sighting of this bird along this region of coastline.

An Osprey (*Pandion Haliaeetus*) nest is known to occur in a redwood tree near the Russian River estuary.<sup>9</sup> Although this bird is not listed as rare or endangered, this nesting site is reported to be at least 50 years old and considered to be a sensitive resource by Sonoma County, and the DFG.

A second bird of prey that occurs in the area and is of concern to the DFG is the Spotted Owl (*Strix occidentalis*). This small owl requires dense old growth forests in creek and river drainages. Populations of this owl are on the decline due to the loss of its habitat. Like the osprey, this owl is not listed as rare or endangered, however it is considered to be a sensitive species by the DFG and Sonoma County.

TABLE 8-3  
RARE AND ENDANGERED SPECIES OF THE SONOMA COAST

<u>Scientific Name</u>	<u>Common Name</u>	<u>Status<sup>1</sup></u>
<u>Plants</u>		
<u>Delphinium luteum</u>	yellow larkspur	State threatened
<u>Lupinus tidestromii</u> <u>var. layneae</u>	Pt. Reyes lupine	C2
<u>Campanula californica</u>	swamp harebell	C2
<u>Cordylanthus maritimus</u> ssp. <u>palustris</u>	Pt. Reyes birds-beak	C2
<u>Agrostis blasdalei</u> var. <u>blasdalei</u>	Blasdale's bent grass	C2
<u>Plagiobothrys strictus</u>	Calistoga popcorn flower	C2
<u>Alopecurus aequalis</u> var. <u>sonomensis</u>	Sonoma alopecurus	C2
<u>Streptanthus glandulosus</u> var. <u>hoffmannii</u>	Hoffman's jewel flower	C2
<u>Animals</u>		
<u>Syncaris pacifica</u>	Calif. freshwater shrimp	State & Federal Endangered
<u>Falco peregrinus anatum</u>	peregrine falcon	State & Federal Endangered
<u>Pandion haliaetus</u>	osprey	LCP
<u>Strix occidentalis</u>	spotted owl	LCP
<u>Phoca vitulina</u>	harbor seals	M.M.P.A.

<sup>1</sup>State Endangered or Threatened - Species listed by the California Department of Fish & Game under the Calif. Endangered Species Act.

Federal Endangered - Species listed by the U.S. Fish and Wildlife under the Endangered Species Act.

LCP - Rare species recognized in the County LCP.

MMPA - Marine Mammal Protection Act.

C2 - Candidate species but not currently listed.

## 8.2.3 SAN PABLO BAY

Habitats

There are four types of native communities or habitats which are recognized as important or rare in the San Pablo Bay area; Bay mud flats, freshwater and saltwater marshlands, and seasonal wetlands. A mud flat is the transition habitat between the aquatic habitat of the Bay and the surrounding upland or terrestrial habitats. The mud flats are devoid of emergent vegetation and are flooded and exposed by daily tidal fluctuations. Algae and plankton thrive in this habitat, providing food for mud dwelling invertebrates which in turn are important food sources for waterfowl and fish. The algae in the mud flats also play an important role in providing sufficient oxygen in the waters of the Bay.

Salt and fresh water marshes are the most productive natural habitats in the environment. Marsh vegetation provides food and cover for many forms of aquatic life. Young fish utilize these areas as rearing or nursery grounds. The marshlands around San Pablo Bay are important feeding and nesting areas as well.

Seasonal wetlands are considered to be of high wildlife value as transitional areas between the marshlands and the upland habitats. During high tides, these wetlands provide a refuge with cover and food for those species that wish to avoid the inundated marshlands. The seasonal aspect of these wetlands creates a unique set of environmental factors; Inundation during the winter and spring months, and dry conditions during the summer and fall months. A unique assemblage of plant species have adapted to these harsh conditions.

In addition to the wildlife values of these important habitat types, development in the Bay has eliminated approximately three-quarters of the original extent of these communities. Consequently, the remaining areas of these habitat types have an added importance as rare or limited productive communities. The CNDDDB has mapped the marshlands and identified them as important native communities.<sup>10</sup>

The Petaluma Marsh is a brackish to saltwater marsh that extends from Petaluma to San Pablo Bay along the Petaluma River. This marsh supports many endangered wildlife species and is an important marshland for migrating waterfowl. Other Bay front marshlands of significance in this area include the San Pablo Bay National Wildlife Refuge

at midshipman point, and the marshlands at the mouth of Gallinas Creek and Novato Creek.

### Wildlife<sup>11</sup>

San Pablo Bay is an essential nesting, feeding, and resting place of the migrating waterfowl Pacific Flyway. Over 75 species of aquatic birds either reside or visit the San Francisco Bay system (see Table 8-5). The estimated populations fluctuate between 600,000 to 800,000. Approximately 92% of the waterfowl species in the Bay are shallow feeding ducks, utilizing the shallow water areas of the Bay system such as San Pablo Bay.

Traditionally San Pablo Bay is visited by more canvasback and scaup ducks than any other location in the Western U.S. It has been estimated that up to one half of the canvasback population of the entire Pacific Flyway winter in San Francisco Bay. On an average year approximately 53% of the birds in the Pacific Flyway visit the San Francisco Bay system, and on some years this increases to 70%.

San Pablo Bay is an important habitat area for shore birds as well. The extensive mud flats around the Bay support a wide variety of invertebrate fauna, which comprise the main diet of many shorebird species. Although shore birds do not use the Bay or its associated wetlands for nesting or breeding, the average winter shore bird population ranges between 100,000 and 200,000 individuals.

Wading birds such as herons and egrets do breed in the wetlands of the Bay. The Napa and Petaluma Sloughs are known to support a number of heron and egret rookeries.

The relative waterfowl habitat values of areas around the San Francisco Bay were identified by the Bay Conservation and Development Commission (BCDC) and presented in Appendix B.<sup>12</sup> The northern and northwest shores of San Pablo Bay, including the Petaluma River delta and marshes and the waters of the open Bay constitute some of the most valuable waterfowl habitat remaining in the Bay Area.

### Rare and Endangered Species

There are a number of rare plant and animal species that are known to occur within and along the banks of the San Pablo Bay.<sup>13</sup> The California Natural Diversity Data Base (CNDDB) of the California Department of Fish and Game, has mapped rare and endangered species over the entire state. The list of rare and endangered plant species known to occur in the San Pablo Bay area are presented in Table 8-4.

There are two rare plant species known to occur in the vicinity of north and west San Pablo Bay, that have no legal standing. The dwarf downingia (Downingia humilis) is a California endemic that has a wide distribution within its range and not believed to be in danger of extinction at this time. Baker's blennosperma (Blennosperma Bakeri) is a Sonoma County endemic which is very rare but not in danger of extinction at this time.

The soft bird's-beak (Cordylanthus mollis ssp. mollis) and the Mason's lilaeposis are suspected to occur in the saltmarsh areas along the San Pablo Bay. These plants are listed as rare under the California Endangered Species Act and is known to occur in the saltmarsh areas of the Petaluma River. Soft bird's-beak is an annual species which is cyclic in its occurrences. It needs just the right conditions to germinate and grow, consequently in some years it may not appear and in other years when conditions are right it may dominate whole areas. Mason's lilaeposis is a small plant that grows on the exposed mud flats and banks of the Bay sloughs.

The salt marsh harvest mouse, peregrine falcon, California brown pelican, and the California clapper rail are endangered species listed under the Federal Endangered Species Act (1973), that are known to occur in the tidal wetlands and open waters of San Pablo Bay. These species are also listed as endangered under the California Endangered Species Act (1970), and thus receive the greatest amount of protection under the federal and state laws. Any project impacts to any of these wildlife species would require approvals from the U.S. Department of Fish and Wildlife as well as the California Department of Fish and Game.

The black rail is listed under the California Endangered Species Act. The black rail is a small secretive bird which is rarely seen. Its current distribution and population size is not known at this time, however, there have been recent sightings of this bird on Tubbs Island and at the mouth of the Petaluma River.

TABLE 8-4  
RARE AND ENDANGERED SPECIES OF SAN PABLO BAY

<u>Scientific Name</u>	<u>Common Name</u>	<u>Status</u> <sup>1</sup>
ANIMALS		
<u>Reithrodontomys</u> <u>raviventris</u>	Salt Marsh Harvest Mouse	State & Federal Endangered
<u>Rallus longirostris</u> <u>obsoletus</u>	California clapper rail	State & Federal Endangered
<u>Laterallus jamaicensis</u>	California Black rail	State Rare
PLANTS		
<u>Cordylanthus mollis</u> spp. <u>mollis</u>	Soft birds beak	State Rare
<u>Lilaeopsis masonii</u>	Mason's lilaeopsis	State Rare
<u>Lathrus jepsonii</u> ssp. <u>jepsonii</u>	Delta tule pea	C2
<u>Aster chilensis</u> var. <u>lentus</u>	Suisun aster	C2

<sup>1</sup> Federal Endangered - Listed by the U.S. Fish and Wildlife Service under the Endangered Species Act.

State Rare and Endangered - Listed by the California Department of Fish and Game under the California Endangered Species Act.

C2 - Species a candidate for listing under the U.S. Endangered Species Act.

## 8.2.4 GEYSERS AREA

Vegetation<sup>14</sup>

The vegetation types in this area of the County are very similar to those described above in the coastal region. However, since this area is beyond the fog belt, the vegetation types are adapted to hot, dry summers. The most extensive vegetation community in this area of the County is the Mixed Evergreen Forest on the cooler northern exposures and higher elevations. Chaparral brushlands form a distinct boundary on the southern exposures. Serpentine Chaparral occurs in the higher elevations of the Geysers area. Isolated pockets of Redwood and Douglas-fir forest occur in some of the deepest, shaded canyons on the western slope of the Mayacamas Mountains above the Alexander Valley. There are many miles of Riparian vegetation along the major waterways leading to and including the Russian River.

On the slopes below the Mixed Evergreen and Coniferous forests, the Foothill Woodland is the dominate vegetation community. Although it may be the most dominate community on these lower slopes, it does grade into Northern Oak Woodlands and Mixed Evergreen Forests on the wetter northern exposures and Live Oak Woodland in areas of southern exposures. The Foothill Woodlands is a community more typically found in the foothills of the Sierra Nevada than in Sonoma County. The dominate trees are the digger pine (*Pinus sabiniana*), and the blue oak (*Quercus douglasii*). The tree density increases on the lower, cooler portions of the slopes in this otherwise open community. The brush layer is dominated by deer brush (*Ceanothus integerrimus*), coffeeberry (*Rhamnus* sp.), scrub oak (*Quercus dumosa*), and manzanita (*Arctostaphylos* sp.). The Northern Oak Woodland more closely approaches a forest form with a dense tree canopy. Dominate tree species include the Oregon white oak and California black oak. Other common associates are: the big leaf maple and bay on wetter sites; coast live oak on the dryer sites; and valley oaks near the valley floors. The understory is composed of poison oak, coffeeberry, snowberry (*Symphoricarpos* sp.) and coyote bush (*Baccharis* sp.). The Live Oak Woodland appears very much like the Foothill Woodland except that the dominate tree species is the coast live oak (*Quercus agrifolia*).

Ponderosa Pine Forest occurs in the Pine Flat and Geysers areas. This forest type is very common in the Sierra Nevada range to the east, and reaches its western most extent in

the Mayacamas Mountains. The trees form open stands in a park-like appearance. A brush thicket of gooseberries (Ribes sp.), thimbleberries (Rubus sp.) and deer brush compose the understory.

### Wildlife<sup>14</sup>

The diverse mosaic of vegetation types in this region of the County provides a great deal of ecotone edge which in turn provides habitat for a high diversity of wildlife species. The Ponderosa Pine Forest and the Foothill Woodlands provide habitat for wildlife species more characteristic of the Sierra Nevada and Klamath Mountains including mountain lions, black bear, ring-tailed cats, and porcupine. The cliffs and rocky outcrops of the Mayacamas Mountains provide nesting habitat for a variety of raptor species. The valley grasslands and surrounding oak woodlands provide habitat for a wide variety of wildlife as well including quail, mule deer, and small mammals.

### Rare and Endangered Species

There are a number of rare plant and animal species that are known to occur in this region of Sonoma County. The California Natural Diversity Data Base (CNDDB) of the California Department of Fish and Game, and the California Native Plant Society (CNPS) have mapped all the rare and endangered species known to occur in the area. The rare and endangered plant species known to occur in this area are listed in Table 8-5. One of the most sensitive areas known to support a number of endangered plant species are the serpentine and peridotite soils. These ultrabasic soils have chemical qualities that are believed to inhibit the growth of many common plant species. Those rare species that have adapted and evolved to survive on these unique soils are able to persist because of reduced competition with the more common species in the surrounding soils. The serpentine and peridotite soils known to occur along the proposed pipeline routes to the geysers are indicated in Figure 9-2.

Three animal species of significance are known to occur in the geysers region; the yellow breasted chat (Icteria virens), the yellow warbler (Dendroica petechia brewsteri), and the osprey (Pandion haliaetus). All three of these species are listed by the DFG as Bird Species of Special Concern, a list of bird species that are believed to have declining populations in California.<sup>15</sup>

TABLE 8-5  
RARE AND ENDANGERED PLANT SPECIES OF THE GEYSERS AREA

Common Name (Scientific Name)	Status <sup>1</sup>	Notes
Clara Hunts milk vetch ( <u>Astragalus clarianus</u> )	1C2/List 1B	This tiny annual found on grassy hillsides on thin volcanic clay or serpentine. Blooms April-June.
Geysers panicum ( <u>Dichanthelium lanuginosum</u> var <u>thermale</u> )	E/C2/List 1B	This grass is found in association with hot springs. It blooms from July-September.
Brandegees eriastrum ( <u>Eriastrum brandegeei</u> )	/C2/List 1B	This plant is generally found on barren soils of volcanic origin. It flowers from May-August.
Snow Mtn. Buckwheat ( <u>Eriogonum nervulosum</u> )	1C2/List 1B	This low, matted perennial bush is known to occur from several localities in the inner Coast Ranges in Lake, Sonoma and Colusa Counties. It grows on serpentine outcrops and slopes. Blooms June-September.
Socrates Mine jewel-flower ( <u>Streptanthus brachiatus</u> )	1C2/List 1B	This annual herb occurs on serpentine soils. It blooms June-July.

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<sup>1</sup>State/Federal CNPS  
 State Endangered = E  
 Candidate species but not currently listed = C2  
 Plants considered rare and endangered by the California Native Plant Society = List 1B

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The osprey populations in California have been recovering due in part to the elimination of the use of the pesticide DDT, which was responsible for the thinning of osprey egg shells. There is a reported nest site in a redwood tree on the Russian River near Dry Creek. There have also been a number of sightings of this bird in the area.

Populations of the yellow breasted chat and the yellow warbler are believed to be on the decline in California due to the loss of their preferred habitat, riparian woodlands. Both these birds have been sighted in the riparian woodlands associated with the Russian River between Healdsburg and the Alexander Valley Road bridge.

### 8.3 IMPACTS OF PROJECT OPERATION

#### 8.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS

##### Impacts

Operation of the spray irrigation system during the summer months could result in continued adverse impacts to the native vegetation in the spray fields. The City of Santa Rosa has indicated that at some point in the near future those sprinkler heads that currently direct spray beneath the canopy of oak trees will be either capped off or refitted with directional heads that will direct the spray away from the trees. This should minimize spray impacts to the existing oak trees.

Based upon the review of aerial photographs and field checks, vernal pool appearing features do occur within some of the spray fields and are indicated in Figure 8-3. The summer spraying is believed to effectively eliminate the vernal pool ecosystem and likely eliminate many of the vernal pool plant species. The native vegetation of vernal pools are uniquely adapted to an annual cycle of periods of inundation during the spring and winter months and desiccated conditions during the summer months. At this time the California Native Plant Society and Sonoma State College is investigating the effects of the spray irrigation and the disruption of this natural cycle and the potential impacts upon the vegetation in these vernal pools.<sup>16</sup> Since this alternative would not increase the spray irrigation areas of the system, there would not be any additional loss of vernal pool habitat in the Santa Rosa area.

Normal operations of the geysers injection is not expected to have any other adverse impacts upon the terrestrial vegetation and wildlife in the project area. However, in the case of a pipeline rupture, there could be adverse impacts depending upon the location of the rupture and volumes of effluent released. The two alternative pipeline routes have approximately 50 creek or stream crossings. A pipe rupture at or near any of these natural waterways could result in soil erosion and removal of vegetation and wildlife habitat in localized areas.

Certain features of this alternative would result in land disturbance and vegetation removal. The most significant disturbances may be associated with the construction of the additional storage ponds in the Santa Rosa and the Geysers areas, and in the construction of the pipeline. The expansion of the treatment plant would also remove existing vegetation, however, this site does not support any native plant communities or endangered species, and thus the construction disturbances associated with the treatment plant expansion are not expected to be significant.

At this time specific location sites for the additional storage ponds have not been determined. The Santa Rosa Plain and the geysers region are known to support a number of rare species and sensitive habitats. The most extensive sensitive habitats in these areas are vernal pools, riparian zones, freshwater wetlands, and serpentine soils. The placement of a storage pond within any of these habitat types would likely result in loss of rare species and/or important wildlife habitat.

Construction of the pipeline could also eliminate or disturb populations of rare plant species along the pipeline route. This impact is expected to be limited to a large extent by the fact that the pipeline is expected to be placed within roadway right-of-way easements. However, the final pipeline alignment may extend beyond the right-of-ways in some areas. Although the placement of the pipeline within roadway easements is expected to limit disturbances of native vegetation, some rare plant species are known to occur on roadway cut banks or roadside drainage ditches. For example, the rare Socrates Mine jewel flower (Streptanthus brachiatus) is known to occur on cut banks within the right of way of roads in the geysers area.

### Mitigation Measures

The following mitigation measures are suggested:

- o All existing and City owned spray irrigation fields should be equipped with directional spray heads to direct effluent spray away from and outside of existing oak tree canopies, or eliminate spray heads from underneath the canopy of existing oak trees. This measure is expected to minimize summer time irrigation of these trees.
- o To minimize impacts associated with a pipeline rupture and disturbances to sensitive habitats along the route, a set of shut-off valves should be placed on both sides of these sensitive areas. The most sensitive of these areas along the pipeline routes are at the Sulphur, Little Sulphur, Macamama, Brooks and Mark West Creek crossings.
- o The additional storage ponds and pipeline route should not be located in areas where rare plants are known to occur, if at all possible. A rare plant survey should be conducted on all potential storage pond sites and the pipeline route prior to the selection of the final pond sites and routes. The rare plant surveys should be conducted during the time that the suspected rare plants are in bloom, and by a qualified botanist.

## ALTERNATIVE 2: YEAR-ROUND RUSSIAN RIVER DISPOSAL

### Impacts

This alternative would involve the use of a rapid infiltration system in addition to the existing spray irrigation. The rapid infiltration basins would occupy approximately 100 acres of land in an area west of Windsor and east of the Russian River (see Figure 4-3). The rapid infiltration basins would require grading and recontouring of the existing topography on the site, most of which is currently occupied by orchards. There are no rare or endangered plant species known to occur in the area of the proposed basins, however this area has not been extensively surveyed. Impacts to riparian woodlands and marshlands along the Russian River are possible depending upon where the basins would be placed in the area.

Continued use of the existing summertime spray irrigation fields would result in existing adverse impacts to the existing native vegetation in the fields. Modifications to the sprinkler heads as described in Alternative 1 should minimize these impacts.

### Mitigation Measures

The following mitigation measures are suggested:

- o All existing and City owned spray irrigation fields should be equipped with directional spray heads to direct effluent spray away from and outside of existing oak tree canopies, or eliminate spray heads from underneath the canopy of existing oak trees. This measure is expected to minimize summer time irrigation of these trees.
- o To minimize impacts associated with a pipeline rupture and disturbances to sensitive habitats along the route, a set of shut-off valves should be placed on both sides of these sensitive areas. The most sensitive of these areas along the pipeline routes are at Mark West Creek crossing.
- o The rapid infiltration system and pipeline route should not be located in areas where rare plants are known to occur, if at all possible. A rare plant survey should be conducted on the infiltration system site and the pipeline route prior to the selection of the final site and route. The rare plant surveys should be conducted during the time that the suspected rare plants are in bloom, and by a qualified botanist.

## ALTERNATIVE 3: OCEAN DISPOSAL

### Impacts

Potential impacts to terrestrial habitats associated with the operations of this alternative would essentially be the same as those identified in Alternative 1. The alternative pipeline routes have fewer creek crossings than the proposed routes to the Geysers (approximately 16 crossings on the northern route and 13 crossings on the southern route), however the pipeline routes in this alternative parallel approximately 10 miles of the Russian River on the northern route and three to four miles of Salmon Creek on the southern route. A rupture along these stretches of pipeline could result in significant adverse impacts to the biotic resources both along and in these waterways.

The northern alternative pipeline route would pass through many groves of redwoods that line Highway 116. Although the pipeline would be laid in the highway right-of-way and every effort would be made to avoid removal or damage to redwoods, at least some trees would be adversely affected. An estimate for the number of trees affected cannot be made until a final pipeline route is selected.

Other sensitive habitats that could be affected if the pipeline left the right-of-way include vernal pools in the Santa Rosa Plain, Pitken Marsh, Atascadero Marsh, Duncan's Mill Marsh and the sand dunes of Great Rock. Any disturbance to these natural areas could affect rare plants.

### Mitigation Measures

The following mitigation measures are suggested:

- o All existing and City owned spray irrigation fields should be equipped with directional spray heads to direct effluent spray away from and outside of existing oak tree canopies, or eliminate spray heads from underneath the canopy of existing oak trees. This measure is expected to minimize summer time irrigation of these trees.
- o To minimize impacts associated with a pipeline rupture and disturbances to sensitive habitats along the route, a set of shut-off valves should be placed on both sides of these sensitive areas. The most sensitive of these areas along the pipeline routes are at the Mark West crossing and on the pipeline sections paralleling Salmon Creek and Russian River.
- o The pipeline route should not be located in areas where rare plants are known to occur, if at all possible. A rare plant survey should be conducted on all potential storage pond sites and the pipeline route prior to the selection of the final pond sites and routes. The rare plant surveys should be conducted during the time that the suspected rare plants are in bloom, and by a qualified botanist.
- o The pipeline route following Highway 116 should be located to minimize removal of, or damage to, coastal redwood trees.

**ALTERNATIVE 4: SAN PABLO BAY DISPOSAL****Impacts**

Impacts to the terrestrial biotic resources as a result of the operations of this alternative would be very similar to those described for Alternatives 1 and 3. The proposed pipeline route for this alternative would have approximately 22 creek crossings. A rupture in the immediate area of any of these crossings could result in adverse impacts to the biotic resources both along and within these waterways. The proposed freshwater marshland at the northwest end of San Pablo Bay could have significant positive impact, if it functioned as planned. This wetland would replace existing agricultural lands with a limited, badly-needed and valuable natural habitat in this region.

If it is necessary to site the pipeline outside of the paved roadway and onto adjacent vegetated areas in areas, it is possible that sensitive habitats and or species could be disturbed or destroyed. These impacts could occur in most any area vegetated with native species, but are most probable in the following sensitive areas:

The portion of the pipeline which passes through the Santa Rosa Plain from the Laguna treatment plant to Cotati, is an area that is known to support a number of vernal pools and their associated rare plant species (see Figure 8-3). Some of these pools are located very near the existing paved roadways within the right-of-ways.

The portion of the pipeline route along Lakeville Road will pass very near a portion of the Petaluma River Marsh that is owned by the Sonoma Land Trust, and crosses the marsh at the Highway 37 bridge.

As the pipeline moves south of black point along the western edge of the San Pablo Bay, it will be passing through native salt marsh habitat and agricultural lands. The marshlands associated with Novato and Gallinas Creeks as well as those adjacent to the Bay have been identified as essential habitat for the endangered salt marsh harvest mouse and the California clapper rail. Any disturbance of these marshlands would require approvals from the U.S. Fish and Wildlife Service.

The pipeline route would have approximately 22 creek crossings including the Laguna de Santa Rosa and the Petaluma River.

### Mitigation Measures

The following mitigation measures are suggested:

- o All existing and City owned spray irrigation fields should be equipped with directional spray heads to direct effluent spray away from and outside of existing oak tree canopies, or eliminate spray heads from underneath the canopy of existing oak trees. This measure is expected to minimize summer time irrigation of these trees.
- o To minimize impacts associated with a pipeline rupture and disturbances to sensitive habitats along the route, a set of shut-off valves should be placed on both sides of these sensitive areas. The most sensitive of these areas along the pipeline routes are at the Sulphur, Little Sulphur, Macamama, Brooks and Mark West Creek crossings.
- o The additional storage ponds and pipeline route should not be located in areas where rare plants are known to occur, if at all possible. A rare plant survey should be conducted on all potential storage pond sites and the pipeline route prior to the selection of the final pond sites and routes. The rare plant surveys should be conducted during the time that the suspected rare plants are in bloom, and by a qualified botanist.

### **8.4 CONSTRUCTION IMPACTS**

#### ALL ALTERNATIVES

#### Impacts

Some adverse impacts on vegetation, beyond those discussed above, could occur if construction activities are not conducted carefully.

#### Mitigation Measures

The following mitigation measures are suggested:

- o A Section 1603 Stream Alteration Agreement should be secured from the California Department of Fish and Game for all proposed construction within the banks of any natural stream or creek.
- o Construction staging and storage areas should be located to avoid impacts on native vegetation.
- o No trees should be removed other than those indicated on construction drawings.

- <sup>1</sup>Laguna de Santa Rosa Environmental Analysis and Management Plan, County of Sonoma, 1977.
- <sup>2</sup>California Natural Communities, The California Department of Fish & Game Natural Diversity Data Base (CNDDDB), 1983.
- <sup>3</sup>Laguna de Santa Rosa Environmental Analysis and Management Plan, op.cit.
- <sup>4</sup>Milo Baker, Chapter of the California Native Plant Society, Betty Lovell Guggolz, Rare Plant Chairperson.
- <sup>5</sup>California Natural Diversity Data Base (CNDDDB), Department of Fish and Game, Sacramento, CA. Date request November 1985.
- <sup>6</sup>Sonoma County Plant and Animal Habitat Associations, Madrone Associates, 1976.
- <sup>7</sup>Sonoma County Resource Maps, Sonoma County Planning Department.
- <sup>8</sup>Sonoma County Plant and Animal Habitat Associations, op.cit.
- <sup>9</sup>Sonoma County Local Coastal Plan, Sonoma County, 1981.
- <sup>10</sup>CNDDDB, November 1985 op.cit.
- <sup>11</sup>The Changing Bay, Oceanic Society, 1984.
- <sup>12</sup>San Francisco Bay Plan. San Francisco Bay Conservation and Development Commission, 1983.
- <sup>13</sup>CNDDDB, November 1985 op.cit.
- <sup>14</sup>Madrone Associates, 1976.
- <sup>15</sup>Bird Species of Special Concern in California, California Department of Fish and Game, Sacramento, 1978.
- <sup>16</sup>Betty Lovell Guggolz, Rare Plant Chairperson of the Milo Baker Chapter of the CNPS, phone conversation, April 22, 1986.
- <sup>17</sup>Betty Lovell Guggolz, phone conversation, October 22, 1986.



# GEOLOGY & SOILS



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## 9 GEOLOGY AND SOILS

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### 9.1 INTRODUCTION

The geologic/soils effects of the proposed wastewater treatment alternatives must be considered from two points of view: the effects of the project on the environment and the effects of the environment on the project. In the first category, the short-term impacts of pipeline and treatment plant construction are considered, as is the subject of increased local seismicity at The Geysers. In the second category, the geologic hazards that could damage the structural parts of the alternatives are considered. These hazards must be taken into account during the design of the project to avoid, reduce or eliminate the possibilities of spills and disruption of service, which, in turn, would have further environmental consequences.

### 9.2 SETTING

#### 9.2.1 BEDROCK GEOLOGY

The geology of Sonoma County (and adjacent portions of eastern Marin County) can be explained by the theory of plate tectonics. The earth's mantle is composed of several large plates which move relative to each other. The San Andreas Fault is at the junction of two such plates. The Pacific Plate, on the west side of the fault, is moving north relative to the North American Plate on the east. One of the results of this movement is the regional rock deformation that provides the general northwest-southeast trend of valleys and ridges in Sonoma County. Another result is the regional seismicity that is common to the entire Bay Area.<sup>1</sup>

The geologic formations in the County mostly belong to the Coast Ranges on the western edge of the North American Plate. The San Andreas Fault separates the North American plate from the Pacific Plate, parts of which form the land masses west of Tomales Bay and along the Sonoma coast north of Fort Ross. East of the San Andreas Fault, the oldest

bedrock is the Franciscan Assemblage. Much younger rocks, including the Wilson Grove sandstone/tuff, the Petaluma claystone/mudstone and the Sonoma volcanics, overlie the Franciscan deposits. The fluvial gravels, sands, silts and clays of the major northwest-southeast trending valleys are Quaternary or younger in age.<sup>2</sup>

The FRANCISCAN ASSEMBLAGE<sup>3</sup> comprises a group of sandstones, shales, cherts, graywackes and conglomerates that underlie 40% to 50% of Sonoma County. Serpentine occurs widely throughout the assemblage. These rocks originated during a span of time 40 to 150 million years ago. They were deposited as sediments in a deep ocean trench at the juncture of two crustal plates. During that time the oceanic plate was being thrust under the continental plate, creating massive deformation of the accumulated sedimentary, metamorphic and volcanic rocks. This is indicated by the intense faulting, fracturing and shearing throughout the Franciscan Assemblage.

There are two major sub-units in the Franciscan Assemblage; the "melange" and the "graywacke". The intensively sheared and fractured rocks form a shale-rich melange containing more resistant greenstone and serpentine knobs. Serpentine occurs in small separated masses, but also is present as a linear belt near The Cedars. This belt separates the melange from the other major Franciscan sub-unit; the graywacke, a dense massive sandstone. Intermixed with the Franciscan Assemblage are linear beds of the Great Valley Sequence; primarily hard, massive, resistant pebble and cobble conglomerates.

Rocks in the southern half of Sonoma County and eastern Marin County are much younger than the underlying Franciscan basement rock. All were deposited about 7 million years ago. The PETALUMA FORMATION,<sup>4</sup> composed of claystone, siltstone and mudstone, was deposited in a freshwater estuarine environment during the early Miocene. The WILSON GROVE FORMATION (formerly the Merced Formation),<sup>5</sup> a uniform siltstone of Pliocene age, was deposited in a marine embayment which covered what is now southwestern Sonoma county. During this epoch, on the east margin of the embayment, lava flows and volcanic ash of the SONOMA GROUP<sup>6</sup> were erupting. The volcanic rocks are dominated by basalt, andesite and interbedded tuff breccia. These rocks are the main constituents of the Sonoma, Sonoma-Napa and Mayacamas Mountains. The Petrified Forest in the northeastern part of Sonoma County contains fossilized redwoods buried by these lava flows and ash falls.

Toward the end of the epoch of structural deformation, valleys and plains were formed in the Sonoma Group. Sediments deposited in these depressions from the eroding highlands created the GLEN ELLEN FORMATION,<sup>7</sup> from Healdsburg to Santa Rosa on the west side of the Sonoma mountains and to the City of Sonoma on the east side of the Sonoma mountains. These rocks include tuff, arkose sandstone, siltstone and pebble conglomerate. Old channel fillings of boulder conglomerate and minor quantities of tuff, diatomite and lignite occur sporadically in this formation.

Valleys and bayfront areas have filled with alluvium since Quaternary time. Streams have deposited sand, silt and clay. "Bay muds" are mostly wet, fine-textured silt and clay. Landslide deposits (colluvium) are locally abundant in the Sonoma Group and especially frequent in the Franciscan Assemblage and Petaluma Formation.<sup>8</sup>

West of the San Andreas fault, are formations that have been repeatedly displaced by the horizontal movement of the Pacific plate during the past 25 million years. Some of this land has moved as much as 200 miles northwest from its original place of deposition. This crustal shift has produced the granite block known as Bodega Head, the only occurrence of granite in Sonoma County. It resembles the granite of the Tehachapi Mountains far to the south. Other rocks west of the San Andreas Fault are mostly Late Cretaceous and Early Tertiary marine sandstone, shale and conglomerate (98 million to 24 million years old). Among the various formations are quartzite and recrystallized limestone that are older than the Franciscan Assemblage. Granitic rocks, as well as sandstone, mudstone and conglomerate of about the same age as the Franciscan Assemblage also occur on the west side of the fault. Sandstones, siltstones and shales, ranging in age from 65 million years to about 25 million years outcrop at Point Reyes and along the Sonoma north coast. Small volcanic inclusions occur near Black Point. As many as three levels of coastal terraces were eroded into the rocks indicating 1,000 feet of up-lift has occurred within the past 2 to 3 million years. Some deposits of dune sand and alluvium, as well as terrace deposits, all of Quaternary age (less than 2 million years old), are scattered along the Sonoma coast.<sup>9</sup>

Geologic conditions specific to each alternative and to particular areas of Sonoma and Marin Counties are discussed in the following sections of this chapter.

### 9.2.2 SOIL TYPES<sup>10,11,12</sup>

The soils of Sonoma County belong to two major groups which are further subdivided into 15 associations. Two additional associations occur in eastern Marin County. The major soil groups are related to the substrate on which the soils have developed. Soils in the basins and on tidal flats, flood plains, terraces and alluvial fans were developed on the unconsolidated deposits of the valleys and shores. Soils of the high terraces, foothills, uplands and mountains generally were developed on bedrock terrains or on bedrock thinly overlain by unconsolidated material. The City of Santa Rosa is on the Huichica-Wright-Zamora soil association; a group of loams and silty clay loams developed on low terraces and alluvial fans in the Cotati-Petaluma valley. West of Laguna de Santa Rosa, the majority of the soils belong to the Hugo-Josephine-Laughlin association; a group of well-drained, gently to steeply sloping loams and gravelly loams that occur on the mountain sides almost to the Pacific coast. North of Santa Rosa to The Geysers, various soil associations developed on steeply sloping terraces and uplands are composed of loams, clay loams and gravelly loams. The Russian River valley from Alexander Valley (Jimtown) to Cloverdale consists of the Yolo-Cortina-Pleasanton association; a gravelly sandy loam and clay loam developed on the nearly level or moderately sloping valley floor. From Santa Rosa southeast to San Pablo Bay, the soils range from clays and clay loams to clays and fine sandy loams in the Clear Lake-Reyes and Haire-Diablo Associations. Each soil association is described briefly below. Some of their characteristics are listed in Table 9-1.

Soils of the Clear Lake-Reyes association (Association 1) principally occur along Laguna de Santa Rosa and cover much of the area from Rohnert Park-Cotati downstream to San Pablo Bay. These soils are poorly drained, consisting of nearly level to gently sloping clays and clay loams. These soils are used mainly for irrigated pasture. They correspond to the Reyes-Novato soils in eastern Marin County.

The Haire-Diablo soils (Association 2) occur from the south end of the Santa Rosa Plain nearly to San Pablo Bay. They are moderately well drained to well drained, gently sloping to steep fine sandy loams to clays. These soils are used mainly for dry land pasture, with some hay cropping.

TABLE 9-1

## SOIL ASSOCIATION CHARACTERISTICS

<u>Soil Association</u>	<u>Percolation Rate</u>	<u>Expansion Potential</u>	<u>Erosion Hazard</u>	<u>Liquefaction Potential</u>	<u>Soil Strength</u>
1 <sup>1</sup>	S <sup>2</sup>	H <sup>3</sup>	L <sup>3</sup>	VL <sup>3</sup>	P <sup>4</sup>
2	S	M-H	M-H	VL-L	P-F
3	VS-MS	H	L-M	VL-L	F-P
4	MS	L	L	M	F
5	MS-VR	L	L	L-M	F-G
6	S-M	L-H	H	VL-L	F
7	VS-S	H	H	VL-L	F-P
8	M	M	H	VL-L	F-P
9	M-R	L-M	H-VH	L	F
10	MS-M	L-M	H-VH	L-M	F
11	M	M-L	H-VH	L	F
12	M-S	M-H	H-M	VL	F-P
13	S	M-L	H-M	VL-M	F-P
14	S-MR	L-H	M-H	VL-M	P-F
15	M-MS	M	M	L-M	F
16	M	M	H	L	F-P
17	M-MR	L	VH	L	F

<sup>1</sup> See text for Soil Association names.

<sup>2</sup> VR = Very Rapid  
R = Rapid  
MR = Moderately Rapid  
M = Moderate  
MS = Moderately Slow  
S = Slow  
VS = Very Slow

<sup>3</sup> VH = Very High  
H = High  
M = Moderate  
L = Low  
VL = Very Low

<sup>4</sup> G = Good  
F = Fair  
P = Poor

Source: USDA-SCS, 1972, 1985.

The Huichica-Wright-Zamora soils (Association 3) cover most of the Santa Rosa Plain. These soils are somewhat poorly drained to well drained, nearly level to strongly sloping, loams to silty clay loams. The principal use of these soils is for pasture and hay.

The Pajaro soils (Association 4) occur along Green Valley Creek (west of Sebastapol), along Estero Americano (South of Bodega) and between Petaluma and Two Rock. These soils are somewhat poorly drained, nearly level to gently sloping, fine sandy loams to clay loams. The principal soil uses for dry farming or irrigated pastures and hay.

Soils of the Yolo-Cortina-Pleasanton association (Association 5) are well drained to excessively drained, nearly level to moderately sloping, very gravelly sandy loams to clay loams which are used mainly for pasture. These soils occur along the Russian River north of Healdsburg, west of Healdsburg and along some creek valleys near the Sonoma-Napa County line. These soils are generally excellent farming soils capable of supporting grapes, row crops, orchards or pasture.

The Spreckels-Felta association (Association 6) soils occur in the foothills in the east central portion of the County. These soils, which are used as range and pasture land, are well drained, gently sloping to very steep, very gravelly loams to clay loams.

The Yorkville-Suther soils (Association 7) occur in the foothills of the Mayacamas and other mountains of the Coast Ranges in the northern part of the County. These soils are moderately well drained, moderately to very steeply sloping loams and clay loams used primarily for pasture and range.

The Gounding-Tommes-Guenoc association (Association 8) soils occur along the Russian River east of the Mayacamas and throughout the Sonoma Mountains. These soils are used mainly for range, pasture and watershed. They are well drained, gently to very steeply sloping clay loams.

Kidd-Forward-Cohasset soils (Association 9) are used for range, watershed and some recreation and timber. Occurring along the Sonoma-Napa County line, these soils are excessively drained to well drained, moderately sloping to very steep, gravelly and stoney loams.

Los Gatos-Henneke-Maymen soils (Association 10) occur in the Mayacamas Mountains in the northeast corner of the County. They are well drained to excessively drained, moderately to very steeply sloping loams, gravelly loams and gravelly sandy loams, used primarily as watershed and for wildlife habitat.

The Hugo-Josephine-Laughlin soils (Association 11) occupy about one-third of the County, occur ring in the Mayacamas and throughout the ridges of the Coast Ranges from Sebastapol to the Sonoma-Mendocino County line. These soils are well drained, gently to very steeply sloping gravelly loams and loams. They are used for commercial timber production as well as pasture and range for sheep.

Soils of the Steinbeck-Los Osos association (Association 12), in the southwestern portion of the County, are moderately drained to well drained, gently sloping to steep loams and clay loams, which are used mainly for range and pasture.

The Goldridge-Cotati-Sebastapol soils (Association 13) also occur in the southwestern part of the County. These soils are moderately well drained to well drained, gently sloping fine sandy loams and sandy loams. Their primary use is for apple orchards.

Kneeland-Rohnerville-Kinman soils (Association 14) occur along the Pacific coast north of Bodega Bay. These soils are well-drained to moderately well drained, nearly level to steeply sloping loams and clay loams. They are primarily used as range or pasture.

Soils of the Empire-Castper-Mendocino association (Association 15), along the South Fork Gualala River, in the northwest corner of the County, are well drained to moderately well drained, strongly to steeply sloping sandy loams and sandy clay loams, which are used mainly as timberland.

Bressa-McMullin soils (Association 16) occur in the uplands of eastern Marin County, near San Pablo Bay. These soils are well drained, steeply sloping gravelly loams and gravelly sandy clay loams. They are used for grazing and recreational or homesite development.

Tocaloma-McMullin soils (Association 17) also occur in eastern Marin County uplands. They are well-drained, very steeply sloping loams and gravelly loams, used for firewood production.

Soil conditions affect the possibilities of effluent disposal of irrigation, the agricultural quality of the soil, and the general feasibility of individual waste disposal by septic tanks and percolation. Specific soil conditions related to each alternative are discussed in the Soil Hazards section and in the Impact section of this chapter.

### 9.2.3 LAGUNA DE SANTA ROSA PLAIN<sup>13</sup>

The Laguna de Santa Rosa Plain occupies a portion of a northwest-trending structural depression in the southern part of the Coast Ranges. This depression divides the Mendocino Range on the west and the Sonoma Mountains on the east.

The Plain is deeply underlain by the Franciscan Assemblage which is exposed in the rugged terrain surrounding the Plain. The Franciscan is overlain by the Wilson Grove and Glen Ellen formations. The Wilson Grove Formation, exposed or at shallow depth in the area west of the Laguna, generally contains moderate to steeply rolling terrain and is covered by 1 to 4 feet deep of loose silty sandy loam. The Glen Ellen Formation is exposed or at shallow depth in the area east of the Laguna. This formation underlies most of the plain and characteristically consists of poorly sorted gravel, sand, silt and clay. Recent alluvium lies along the flood plain of all streams in the Laguna area.

### 9.2.4 RUSSIAN RIVER<sup>14,15</sup>

The Russian River enters Sonoma County near Cloverdale, flowing in the northwest-southeast trending Alexander Valley that eventually connects with the Santa Rosa Plain. South of Healdsburg the river arcs to the west, across the trend of the Coast Ranges to the Pacific coast. Except for the extreme western margin, the Russian River area is underlain by the Franciscan Assemblage. Franciscan melange surrounds a core of sandstone west of Santa Rosa. Serpentine is most predominant in the Harrison Grade area. Coast Range Basalt occurs north of Forestville. A band of alluvium varying in width parallels the Russian River. The Pacific margin contains terrace deposits (sand and rock fragments) formed during the last two million years on the uplifted Wilson Grove and Franciscan rock.

Soils between Healdsburg and Forestville are the gravelly to clayey loams of the Yolo-Cortina-Pleasanton association. The soils provide good to fair support. They generally

are developed on more than 100 feet of alluvium overlying the bedrock. The soils near the river in the Windsor area are mostly Cortina gravelly sandy loams and Yolo loam or sandy loam. They are subject to flooding and vary in permeability from moderate to very rapid. Their limitations for use as filter fields varies from slight to severe depending on the amount of very fine (clayey) material at any particular site. Slopes are less than 5%. Cortina soils have good strength, low compressibility and good resistance to piping. Yolo soils vary in strength from fair to poor, are moderately compressible and have poor to good resistance to piping.

From Forestville about to Highway 1 at Bridge Haven, the soils are the gravelly loams of the Hugo-Josephine-Laughlin association. These are fairly strong and moderately permeable soils developed on mountain slopes above the river's narrow alluvial plain. Soils between Highway 1 and the coast are the loams of the Kneeland-Rohnerville-Kinman association. Support strength in the association is mostly poor varying to fair. Permeability tends to be low.

Except for the area between Healdsburg and Forestville, the slopes along the river all exceed 30%. At these steep slopes all bedrock is of low stability. The extensive Franciscan melange and the weakly consolidated Wilson Grove Formation are relatively unstable compared to the sandstone and basalt. Maps of landslides in the area show active landsliding associated with the Franciscan melange, but the whole area is potentially unstable because it is so steep.

#### 9.2.5 THE GEYSERS<sup>16,17</sup>

The Geysers Geothermal Field includes 70 square miles in the Mayacamas Mountains of northeastern Sonoma County and western Lake County, where a rare geologic configuration has allowed water to contact hot rock formations and produce steam with a pressure and temperature in excess of 120 psi and 400°F. This unusual area of steam vent and hot springs occupies a graben (a fault-bounded structural valley) drained by Big Sulphur Creek. The region lies within Franciscan rocks. The subterranean heat source probably is related to residual volcanic activity at great depth. The valley appears to be underlain by Franciscan serpentines and greenstones that were down-faulted into the surrounding graywackes (sandstones).

The largest area of natural geothermal activity is along Geyser Creek, a tributary of Big Sulphur Creek, and covers less than 20 acres. Geyser Canyon contains numerous hot springs and several small steam vents with modern geothermal wells located east of Geyser Creek.

This region is the only place in the United States where electric power in commercial quantity is produced from geothermal sources. Power development began in 1921, when the first steam wells were drilled. By 1925, eight wells had been completed, but were abandoned because there was little market for the power. In 1955, more wells were drilled, generating equipment was installed, and power was again produced in 1960. The geothermal area at The Geysers produces dry steam with few corrosive products apart from sulfur. This characteristic has facilitated development and made the region the world's largest producer of geothermally generated electric power. Approximately 1,100 megawatts of power are being generated at The Geysers with a projected production capacity of 2,000 megawatts.

As steam production continues, pressure and steam flow decline, thereby creating a need to drill new production wells (makeup wells) to maintain a constant rate of steam production. The overall field pressure has declined, as a result of steam production, from over 500 psi to less than 350 psi in some parts of the field. Steam production has increased from less than 1 billion pounds per month in 1967 to 11 billion pounds per month in 1980.

#### 9.2.6 PACIFIC COAST<sup>18,19</sup>

Between the Russian River and Bodega Head, most of the coast consists of State Parkland. Terrace deposits occur along the entire coast, but sand dunes are limited to the area between Bodega Bay and Jenner. The terraces were uplifted and tilted eastward by crustal deformation during the last two million years. Material deposited on the surface of the terraces was uplifted with them. The surface soils are the Kneeland-Rohnerville-Kinman association developed on alluvial deposits over the Franciscan Assemblage and the Wilson Grove Formation. Landslides are common in all the steep bedrock and soil formations along the coast. The unconsolidated terrace deposits (including dune sand) are subject to liquefaction under certain conditions of saturation and seismically induced groundshaking.

The San Andreas Fault, which parallels the coastal margin, shows evidence of displacement during historic times. Other potentially active faults are the Joy Wood Fault near Bodega and some traces near Bodega Bay. Surface rupture is possible at these sites, but most probable at the more recent displacements. The coastal terraces and sand dunes of Bodega have the greatest potential for increased groundshaking and liquefaction potential. Less stable slopes under "normal" geologic conditions are most likely to slide during earthquakes. This puts a majority of the area at the risk of earthquake-induced landslides. Tsunamis are possible along the entire coast, but may run up several miles inland at the Russian River, Salmon Creek and Bodega Bay.

#### 9.2.7 PETALUMA VALLEY<sup>20,21</sup>

The Petaluma Valley continues in the northwest-southeast structural trend of the Santa Rosa Plain. It contains as much as 300 feet of unconsolidated alluvial and intertidal sediment overlying the Petaluma Formation. The bedrock consists of folded layers of mudstone, claystone, shale and various fine to coarse sand stone. It is of low to moderate strength and quite prone to landsliding. It is also oil and gas bearing in the foothills east of Petaluma. The soils belong to the Clear Lake-Reyes association. They are clays and clayey loams of poor strength and low permeability.

Slopes in this area are mostly moderate to gentle, although steep slopes occur locally in hilly sections. Steep to moderate slopes in the Petaluma Formation west of the valley contain many landslides which are actively slumping into the ravines dissecting the foothills.

#### 9.2.8 SAN PABLO BAY MARGIN<sup>22,23,24</sup>

The Petaluma Valley eventually opens out to San Pablo Bay. San Pablo is part of the larger San Francisco Bay System which represents a flooded valley in the Coast Ranges that formed during the periods of lower sea level scores of thousands of years ago. The Bay margin contains thick deposits of Bay mud. These sediments consist of silt, sand and clay that are thoroughly saturated (up to 60% of the volume of Younger Bay mud is water) and, in places, extend to several hundred feet below sea level. The upper (Younger) mud has virtually no frictional bearing strength and will subside or flow laterally when loaded from above. Clear Lake-Reyes and Reyes-Novato clays develop on these deposits. Most

of the Bay margin at the mouth of the Petaluma Valley is within the San Pablo Bay National Wildlife Refuge.

#### 9.2.10 GEOLOGIC HAZARDS

There are two major types of hazardous geologic conditions to be considered in the study area: seismicity and slope instability. Santa Rosa, Sonoma County and the entire Bay Area are part of the most active SEISMIC regions in the United States. Each year, low and moderate magnitude (M) earthquakes occurring within or near this region are felt by residents of the northern Bay Area. Since the mid-nineteenth century about 150 local earthquakes have been felt in the county. Ten of these temblors were damaging; those of 1906 and 1969 being the most destructive. The April 1906 earthquake on the San Andreas Fault registered about M8.3 on the Richter Magnitude Scale<sup>25</sup> and practically destroyed the business district of Santa Rosa, killing several scores of people. The October 1969 earthquakes on the Healdsburg fault registered M5.6 and M5.7. No deaths occurred, but several million dollars damage was done including numerous breaks in the water system pipes in the eastern part of town. Most recently, the M4.9 earthquake along the Hayward fault (26 January 1986) was felt in the county, but no damage was reported to major pipeline facilities. Current estimates of the recurrence interval for damaging earthquakes in Sonoma County range between 20 and 30 years.<sup>26</sup>

There are several POTENTIALLY ACTIVE FAULT ZONES that could affect pipeline facilities in the study area. These include faults that are historically active (during the last 200 years), those that have been active in the geologically recent past (about the last 10,000 years, usually referred to as the Holocene) and those that have been active at some time during the Quaternary geologic period (the last 2 million years). The San Andreas, Healdsburg-Rodgers Creek, Maacama and West Napa fault zones are all historically active. The Holocene faults occur as branches within these fault zones and within the Collayomi fault zone of Lake County. Parts of each of the major fault zones have been classified as Quaternary because they do not display evidence of recent movement. Also in this Quaternary classification are the Burdell Mountain, Tolay, Americano, Bloomfield, Joy Woods, Geyser Peak and Cobb Mountain fault zones.<sup>27,28</sup>

Of the major potentially active fault zones, the Healdsburg is capable of generating a maximum expected earthquake of M6.7; the Rodgers Creek, a M7.0 earthquake; and the

northern section of the San Andreas, a M8.3 earthquake. Earth quakes of these magnitudes are sufficient to create ground accelerations in bedrock and in unconsolidated deposits severe enough to cause major damage to structures, foundations and underground pipelines.<sup>29</sup>

Numerous other faults exist through-out the study area. These faults are pre-Quaternary in origin, generally being related to the Coastal thrust belt or the Coast Range thrust. They were active tens of millions of years ago, but have shown no evidence of activity during the last 2 million years.

Hazards related to seismicity include surface rupturing, groundshaking, landsliding and liquefaction. SURFACE RUPTURING along the trace of a fault affects all types of material, however, it does not always show clearly in a loose or water-saturated soil. Damage due to surface rupturing is limited to the actual location of the fault-line break, unlike damage from groundshaking that can occur at great distances from the fault. Even a moderate earthquake can be accompanied by enough surface rupturing to damage buried pipelines that have not been adequately protected where they cross fault traces.<sup>30</sup>

Bedrock formations and unconsolidated deposits (soils) exhibit different responses to seismically induced GROUNDSHAKING. As a general rule, the severity of groundshaking increases with proximity to the epicenter of the earthquake. However, given similar location and seismic energy output, the least amount of damaging vibration would occur on a site that was completely composed of bedrock. A site underlain by major thicknesses of alluvium would experience considerable more damaging vibration because of the unconsolidated material's tendency to deform to a greater degree than the bedrock.<sup>31</sup>

Earthquake-induced LANDSLIDING of steep slopes can occur in either bedrock or unconsolidated deposits. Firm bedrock can usually stand in steeper, more stable slopes than soils are able to maintain, but rock type, grain size, degree of consolidation and angle of the beds all contribute to the strength or weakness of a bedrock hillside. Shales and deeply weathered rocks are very susceptible to slope failures.<sup>32</sup>

Another response to severe groundshaking that can occur in loose soils is LIQUEFACTION. This transformation from a solid to a liquid ("quicksand") state can cause ground settling,

landsliding and lurch cracking. Earthquake-induced liquefaction does not affect bedrock, however it does affect certain types of alluvium under conditions of saturation.<sup>33</sup>

A hazard associated with deep sea seismicity is the generation of TSUNAMIS, commonly known as tidal waves. These seismic sea waves can cause devastating damage along coastal areas thousands of miles from the earthquake's epicenter. The size of any particular wave is dependent on the volume of water displaced at the origin, the orientation of the coast in relation to the wave's travel path and the slope and irregularity of offshore topography. These factors make the character of any given wave unpredictable. Based on a hypothetical 200 year event, run-up zones have been calculated and mapped. Low coastlines, such as beaches or dunes, or bays and estuaries are particularly vulnerable to inundation by tsunamis. This includes much of the Russian River Valley west of Duncan Mills and most of the San Pablo Bay margin. It is important to note that the combination of vertical fault movement and great depths of water needed to generate a tsunami do not exist along the California coast. Consequently the simultaneous occurrence of a locally generated damaging earthquake and tsunami are extremely unlikely.<sup>34</sup>

Static SLOPE INSTABILITY is the major cause of landslides other than those induced by seismic vibration. Landslides are a significant component of the natural erosional processes in the Coast Ranges. Although existing geologic material forms the basis of instability, neutral processes and human activities may initiate landslides in otherwise stable areas.<sup>35</sup>

Geologic material, such as montmorillonite and other clay minerals, have a great capacity to absorb water. The result is a reduction of shear strength in rocks containing the clays. The force of gravity, known as shear stress, can cause landslides when saturated clays reduced the shear strength of a rock below its minimum stability threshold. The Petaluma Formation is marginally stable due to its clay constituents. The sheared and fractured shale matrix of the Franciscan melange make this incoherent mass especially unstable. Vast areas underlain by melange are slumping constantly in Sonoma County. Whole hillsides of this material are creeping downslope in a slow-moving landslide known as an earthflow. Another unstable situation exists where the bedding planes of rock strata are parallel to the surface slope of the ground. In this case the potential exists for whole rock units to slip along a weakened plane.<sup>36</sup>

Fault zones contain weakened rock, crushed by the repeated motion along the fault. Heavy rains can saturate a slope, reducing its shear strength. Stream cuts along the base of a slope can induce sliding by removing needed support from weak zones during high flood stages. Chemical and mechanical weathering can break down rock materials and the seepage from high groundwater levels can increase water concentration, thus reducing strength. The steepness of a slope is a major component of instability because of the unsupported weight of rock and soil that may bear on a weak zone. Such human activities as making road cuts, diverting surface runoff or impounding water can reduce the natural shear strength of bedrock slopes and generate landsliding even in areas of normally low susceptibility.<sup>37</sup>

#### 9.2.11 SOIL HAZARDS<sup>38,39,40</sup>

There are five soil conditions in Sonoma and Marin Counties that could affect the project: impermeability, expansiveness, erosion, liquefaction and landsliding. The potential for each of these properties can be read from Figures 9-2 through 9-5 for the soil associations in the counties. Soils with very slow through moderately slow percolation rates are relatively impermeable and are dominant in the counties. Expansive soils are common and erosion hazards tends to be high. Liquefaction potential generally is low, but the variability of the soil conditions make generalization inappropriate when dealing with specific localities. Soil strength throughout the counties is fair, at best. Combined with steep slopes and shallow depths to bedrock, this indicates generally low stability even under static conditions. Soil creep and/or shallow landslips occur on most slopes steeper than a 15% grade.

IMPERMEABILITY, or a very slow rate of percolation, would be an asset for the construction of storage ponds. These structures would be intended as temporary locations for the water in the system and not as recharge areas. Because these types of soils dominate the Santa Rosa Plain, there would be little difficulty in locating sites with suitable subsurface conditions. This same impermeability can produce structural problems if water collects beneath or within the foundations of buildings. Positive drainage must be established to prevent supporting soils from becoming weakened by saturation. Impermeability also would be a problem in the construction of rapid infiltration ponds. Few sites near the Russian River have large, consistent areas of soil without pockets of fine-grained silts or clays of low percolation rates. Sand for filtration is a basic requirement of this process.

EXPANSIVENESS, or the potential to swell and shrink with repeated cycles of wetting and drying, is another fairly common feature of the soils near Santa Rosa. This characteristic also would be an asset for storage pond liners because the swollen soils would inhibit the absorption of water. Expansiveness would not be an asset for the construction of building or pipeline foundations, or for rapid infiltration ponds. Expansive soils are weak and compressible; they do not provide adequate support for foundations unless they are specially treated. Sometimes they must be removed entirely and replaced with engineered backfill. If left in place these weak soils can cause unacceptable amounts of settlement. The effects can range from the nuisance level (sticking doors and windows) to the major structural damage level (shifted or collapsed foundations). Combined with seismic loads, the effect could be sufficient to make the difference between survival and destruction of a component of the system during a major earthquake. Their swelling and sealing properties would prevent efficient operation of a filtration pond.

EROSION potential is variable throughout the county, but generally is low to moderate in the soils that would be included in most of the construction areas of the alternative projects. This is not true for the soils on the steep slopes of the surrounding terrain along the proposed ocean disposal alignments or along some of the roads that would be followed to The Geysers. Soil erosion can be a problem for the project components in ways similar to those produced by expansive soils. Basically the loss of foundation support can result from excessive erosion. The project could contribute to increased soil erosion in the areas of construction and thereby cause similar problems for existing structures in the project vicinity.

LIQUEFACTION is the transformation of a soil from a solid state to a liquid state as a response to seismically induced groundshaking. The transformation can be very rapid. The soil characteristics of a liquefaction-prone deposit are saturated conditions; loose, uniformly fine sand; little or no clay-sized particles to act as binders; sufficiently violent vibration to increase pore pressure beyond the shear strength of the sand particles. If these conditions occur within about 30 feet of the ground surface, any structures supported on the soils would be subject to tilting or settlement (sometimes very violent and rapid) as the supporting capabilities of the soil diminished. Liquefiable material at or near the ground surface would need to be replaced or recompacted before it could be used as structural support. It is worth noting that Bay mud, either in its natural state or as fill,

is not susceptible to liquefaction. However, the sandy seams that occur as layers within the mud sequence may liquefy. These layers are not continuous, but they may occur over a wide region and at a variety of depths. Except for the Bay mud, the liquefaction potential of the soils in Sonoma County generally is very low to low. Moderate potentials occur in some of the sandier soils of the more rugged terrain in the northern and western parts of the county. It is not a problem on the Santa Rosa Plain where most of the structural facilities for any of the alternatives would be located, but it could effect the alignments for the transportation pipelines and possibly some of the locations for rapid infiltration ponds.

LANDSLIDES, earthslips, mudflows and soilcreeps are all expressions of soil conditions related to the instabilities created by steep slopes, shallow soil development, the presence of an excessive amount of water, or the lack of shear strength in the soil or at the soil/rock interface. Each of these conditions is readily observable in Sonoma County, but usually is reported simply as a "landslide." Earthquake activity does induce some landsliding, but most slides result from the weight of rain-saturated soil and rock exceeding the shear strength of the underlying material. Erosion of supporting material at the toe of the landslide or of the landslide-exposed slopes further contributes to instability.

#### 9.2.12 CONDITIONS AFFECTING WASTEWATER MANAGEMENT ALTERNATIVES

Soil and rock conditions that affect, or are affected by, each alternative are in two categories: conditions along pipeline alignments and conditions at disposal sites. Five alignments are considered: two to The Geysers injection sites (part of which alternatively could serve the rapid infiltration site), two to the Pacific outfalls and one to the San Pablo Bay outfall. The two land-based disposal areas discussed are the irrigation/rapid infiltration area near Windsor and the injection area of The Geysers.

ALTERNATIVE 1. The two alignments being considered for transporting wastewater to The Geysers follow the same route from the Llano Road treatment plant north to the town of Alexander Valley (Jimtown), as shown in Figure 9-1. At Alexander Valley, the western alternative alignment would follow Red Winery Road, Geyser Road and Geyser Resort Road to The Geysers. The eastern alternative alignment would follow Pine Flat Road to the Socrates Mine area.

The western alternative would enter the Healdsburg fault zone where the alignment turns east to pick up Chalk Hill Road. It would emerge about 5 miles north on Chalk Hill Road and cross the Maacama fault zone about 5 miles beyond Alexander Valley on the Geyser Road. The Geyser Peak fault zone would be crossed about 5 miles farther north on Geyser Road. The Healdsburg and Maacama fault zones contain Quaternary and Holocene faults; the Geyser Peak fault is Quaternary. These faults have not moved during the last 200 years, but at least the Holocene traces should be investigated for possible historic activity. The risk of surface faulting along this alignment would be moderate to high depending upon the level of activity discovered. Flexible joints would be needed as part of the seismic design for crossing potentially active faults. The route to The Geysers would cross about 16 miles of alluvium as much as 100 feet deep before reaching Alexander Valley. From the south end of Chalk Hill Road north to The Geysers, the slopes are very unstable. Numerous small landslides occur to the north. Groundshaking generated by maximum credible M6.8 earthquakes along the Healdsburg fault zone could be severe enough to damage or destroy underground pipelines near the fault. Insufficient information is available for the Maacama Fault, but a similar level of risk should be assumed until further studies are completed.<sup>41</sup>

The eastern alternative is in nearly identical circumstances. The differences would be north of Alexander Valley where the eastern route would cross the fault zones. The Maacama fault zone would be crossed about 2 miles northeast of Alexander Valley and the Geyser Peak fault zones about 5 miles northeast of Alexander Valley. Otherwise, conditions pertaining to fault rupture, liquefiable alluvium and unstable hillsides are the same.

Rock and soil conditions at The Geysers are characterized by steep slopes in complex terrain. Earthquakes and landslides are common occurrences that are part of the routine considerations of design engineers working in the region. Micro-earthquake activity is high, up to 10 tremors per day, but these are generally so slight that they cannot be felt. The activity is related to the escape or withdrawal of steam and to the inflow or injection of water but the nature of the relationship is unknown. Currently, all six geothermal plant operators re-inject condensed water, replacing about 20% of the water removed by steam production. Between 3,000 and 10,000 gallons per minute are normally injected by each operator, but this can double during peak winter periods. Injection was started in

1969. Micro-seismicity doubled between 1977 and 1982 and appears to be increasing, but no consistent relationship has been found between the amount of injection and the seismicity.<sup>42</sup>

Landsliding and general slope instability along the route to The Geysers are related to the steepness of the terrain and the shallowness of the soils, as well as to weaknesses within the planes of specific bedrock units. Earthquake activity does induce some landsliding, but most slides result from the weight of rain-saturated soil and rock exceeding the shear strength of the underlying (supporting) material. Erosion of the landslide-exposed slopes further contributes to instability. Erosion hazards tend to be high because the slopes are steep and the coarse-textured soils lack sufficient clay binder to hold them in place unless secured by vegetation. Soil associations and landslide potentials are shown on Figures 9-1 and 9-2.<sup>43</sup>

ALTERNATIVE 2. The area planned for rapid infiltration is a near-level alluvial plain along the Russian River as shown in Figure 9-1. The soils vary in texture from very gravelly sandy loams to loams. The Yolo loam and sandy loam have moderate permeability; the Cortina very gravelly sandy loam is very rapidly permeable; the alluvial and riverwash soils are variable. The soils generally have good strength, and their erosion hazard is low. The soils are subject to deposition from nearby river overflow. A pipeline to the area would cross the Healdsburg fault zone north of Santa Rosa. The site is underlain by deep alluvium and therefore could be subject to severe groundshaking and liquefaction.

ALTERNATIVE 3. Two alternative alignments to an ocean disposal outfall are being considered; one northern route and one southern route. The northern alternative would enter the ocean off the Russian River. The southern alternative would enter the ocean off Salmon Creek. Soils associations and geologic hazards are shown in Figures 9-3 and 9-4.

The northern alternative would pass through Graton, Forestville and Guerneville, then follow Highway 116 to Bridge Haven and to the coast at Goat Rock. The southern alternative would pass through Sebastapol and Bodega, then follow Bay Hill Road to Highway 1 and on to the coast at Salmon Creek.

The land-based portion of the northern alternative would be a relatively low risk alignment in terms of surface faulting. It would not cross any historically active faults onshore. The San Andreas fault is about 2 miles offshore at the mouth of the Russian River where the disposal pipeline would be located. The end of the pipeline would be in the fault zone and therefore at some risk from surface rupturing.<sup>44</sup> Because the exact location of traces within the fault zone would be difficult to determine, seismic reinforcement would be a necessary part of the outfall design. Consideration would be given to designing the pipeline to allow the outfall to be positioned outside the fault zone.

The alignment crosses the trace of a Holocene fault east of Graton. Although not required by the Alquist-Priolo Special Studies Zone Act it would be prudent to investigate this portion of the alignment for potentially active fault traces and incorporate that information in the pipeline design.<sup>45</sup> The use of flexible pipe connections to cross faults would be incorporated in the alignment design.

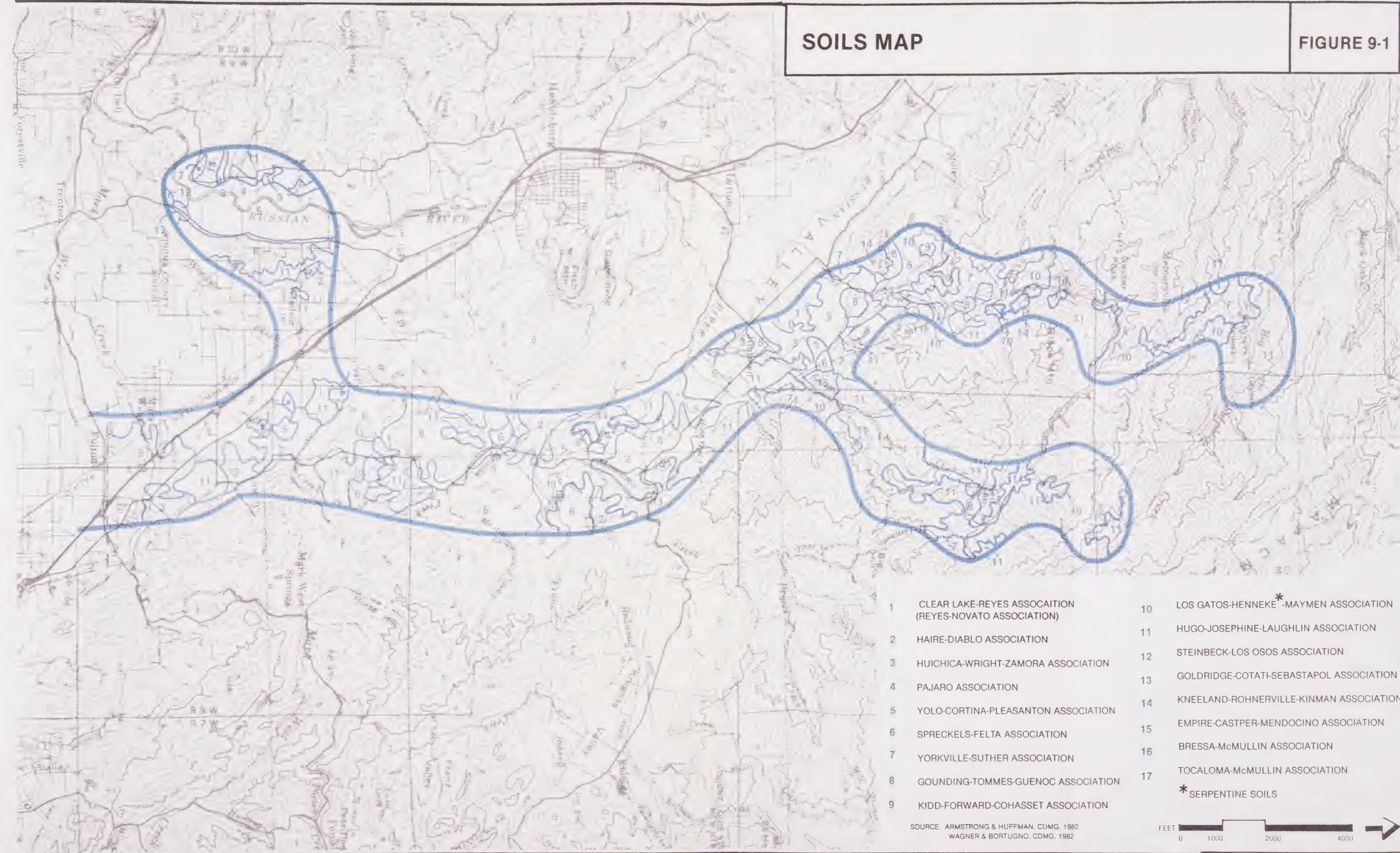
The northern alignment crosses alluvial deposits as much as 100 feet deep east of Laguna de Santa Rosa and as much as 300 feet deep at the Russian River. Because the chronically shallow water table is less than 20 feet below the ground surface, these alluvial deposits may be subject to earthquake-induced liquefaction, if they contain clay-free, fine grained sands within 50 feet of the ground surface. Such deposits can be detected through the use of the soil engineer's standard penetration test. If found, they would need to be grouted, compacted or replaced with engineered fill prior to use as foundation support for the pipeline.<sup>46</sup>

Numerous landslides have been mapped along the alignment between Laguna de Santa Rosa and the Russian River, although much of the terrain is relatively stable. The slopes on the north side of the Russian River generally are less stable than those to the south. Massive landslides exist west of Duncan Mills. Unstable slopes would need to be reinforced or rebuilt if the alignment crossed them or passed directly upslope from them, but it is unlikely that rerouting of the alignment would be needed to avoid active landslides.<sup>47</sup>

Downstream from Duncan Mills to the Pacific Ocean the alignment would cross areas subject to tsunami inundation. Because tsunamis on the California coast generally are

# SOILS MAP

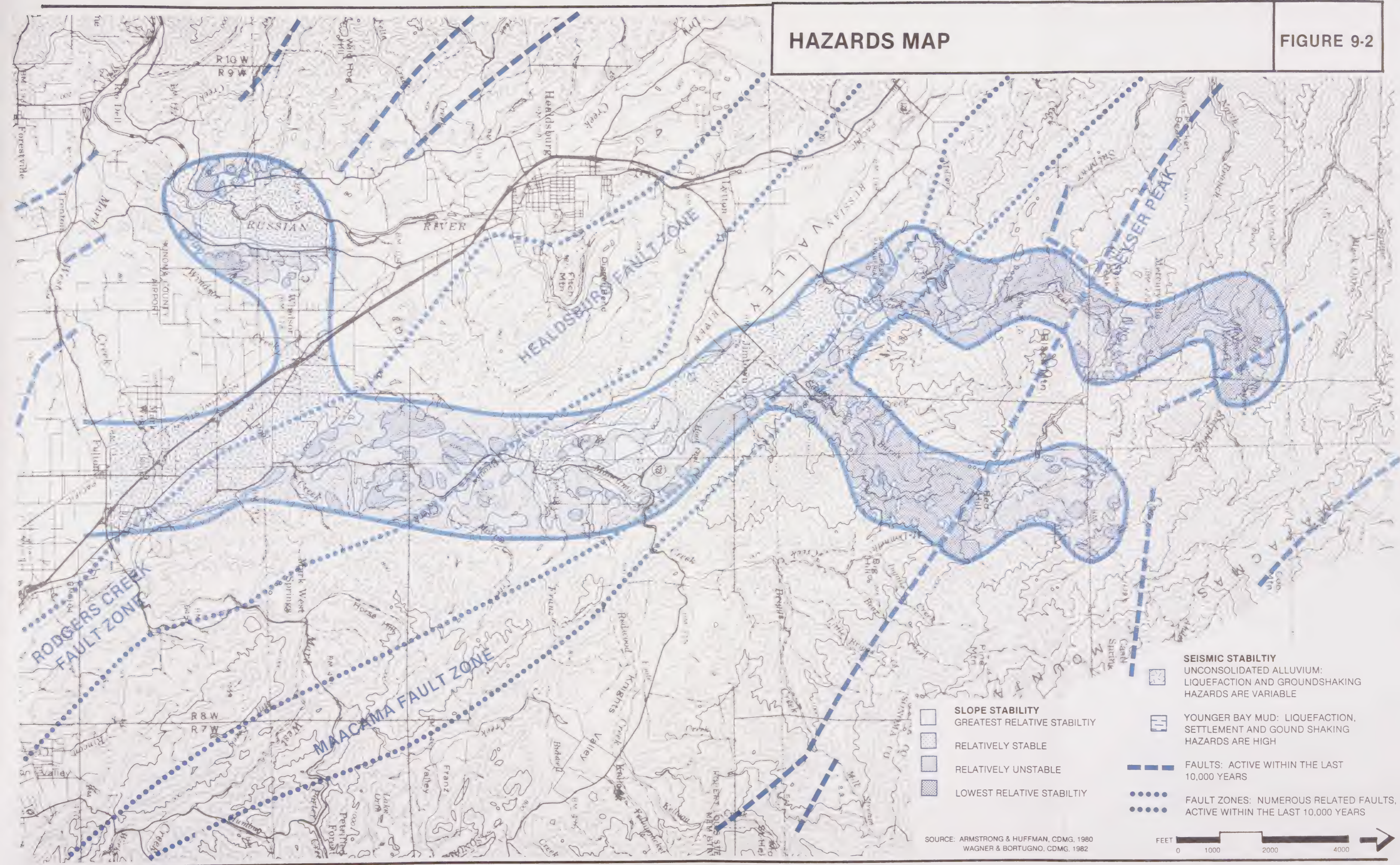
FIGURE 9-1





# HAZARDS MAP

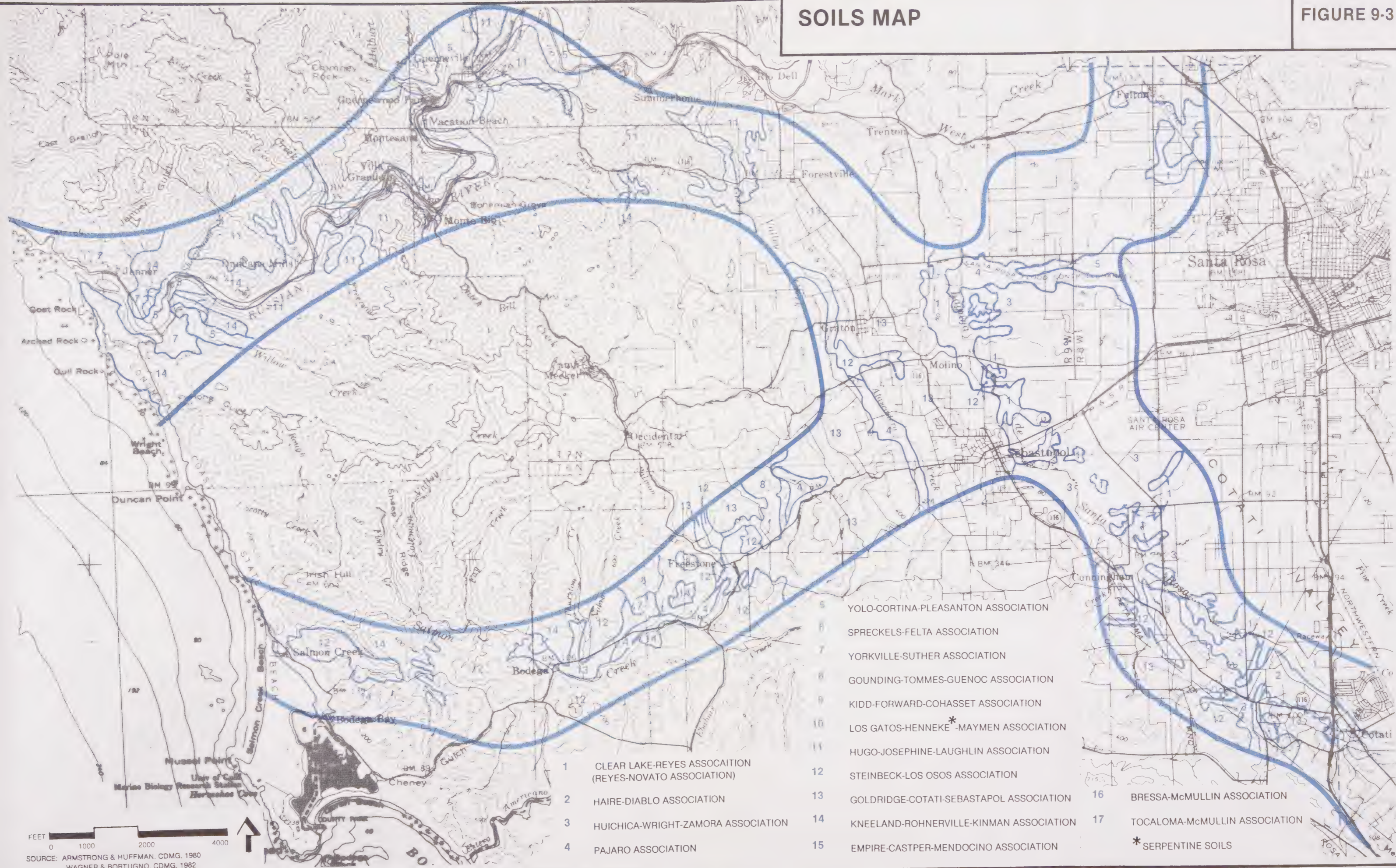
FIGURE 9-2





# SOILS MAP

FIGURE 9-3



- 1 CLEAR LAKE-REYES ASSOCIATION  
(REYES-NOVATO ASSOCIATION)
- 2 HAIRE-DIABLO ASSOCIATION
- 3 HUICHICA-WRIGHT-ZAMORA ASSOCIATION
- 4 PAJARO ASSOCIATION

- 5 YOLO-CORTINA-PLEASANTON ASSOCIATION
- 6 SPRECKELS-FELTA ASSOCIATION
- 7 YORKVILLE-SUTHER ASSOCIATION
- 8 GOUNG-TOMMES-GUENOC ASSOCIATION
- 9 KIDD-FORWARD-COHASSET ASSOCIATION
- 10 LOS GATOS-HENNEKE\* -MAYMEN ASSOCIATION
- 11 HUGO-JOSEPHINE-LAUGHLIN ASSOCIATION
- 12 STEINBECK-LOS OSOS ASSOCIATION
- 13 GOLDRIDGE-COTATI-SEBASTAPOL ASSOCIATION
- 14 KNEELAND-ROHNERVILLE-KINMAN ASSOCIATION
- 15 EMPIRE-CASTPER-MENDOCINO ASSOCIATION

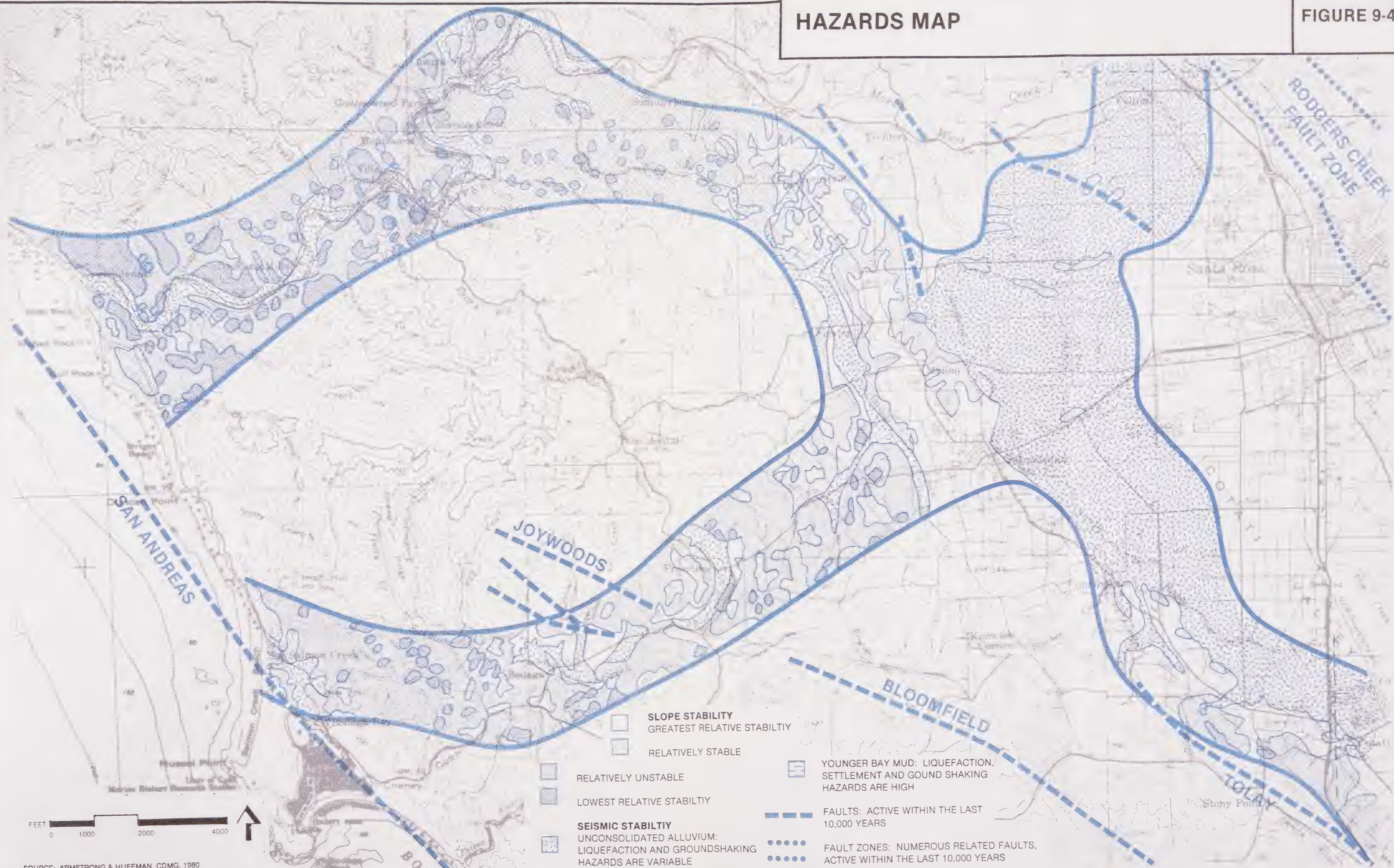
- 16 BRESSA-McMULLIN ASSOCIATION
- 17 TICALOMA-McMULLIN ASSOCIATION
- \* SERPENTINE SOILS

SOURCE: ARMSTRONG & HUFFMAN, CDMG, 1980  
WAGNER & BORTUGNO, CDMG, 1982



# HAZARDS MAP

FIGURE 9-4



SOURCE: ARMSTRONG & HUFFMAN, CDMG, 1980  
WAGNER & BORTUGNO, CDMG, 1982



manifested as rapidly rising tides, rather than as single large seismic sea waves, the alignment would be in danger more from erosive undercutting than from wave shock. This impact would be reduced or avoided through erosion control design and through regular maintenance of buried sections of the pipeline.<sup>48</sup>

Direct hazards from groundshaking would be created by earthquakes epicentered along the San Andreas or Rodgers Creek fault zones. Maximum credible earthquakes on these two faults are M8.2 and M7.0, respectively. Earthquakes of these magnitudes are capable of generating sufficient vibration to damage or destroy underground pipelines. Pipeline sections would need to be designed to resist the lateral forces generated by earthquakes in the study area. The proper level of vibration to be used in the design would be determined by a seismic engineer.<sup>49</sup>

The southern alternative would cross the deep alluvium east of Laguna de Santa Rosa, and would pass through landslide-prone country west of Bodega. The alignment would cross moderately deep alluvium near Freestone, Bodega and from Bodega Bay to the mouth of Salmon Creek. Landslide potential is moderate to low along the route as far west as Bodega, beyond which slopes become very unstable. Numerous small landslides exist that would have to be given consideration. Tsunami run-up occurs west of the town of Salmon Creek.<sup>50</sup>

The route would pass south of the Joy Woods Fault (Holocene) between Freestone and Bodega, but would cross the San Andreas Fault south of the town of Salmon Creek. The outfall pipe would cross the San Andreas Fault off the mouth of Salmon Creek, making this a relatively high risk alignment in terms of surface rupture potential.<sup>51</sup>

ALTERNATIVE 4. The option for piping wastewater to San Pablo Bay would follow an alignment through Cotati, Petaluma and Lakeville to Highway 37. It would cross the mouth of the Petaluma River and follow the Bay margin south to an outfall off Los Gallinas Creek. Soils associations and geologic hazards are shown in Figure 9-5 and 9-6.

From the Llano Road treatment plant, the alignment would pass east of a branch of the Tolay fault near Penngrove and would cross the fault east of Petaluma. The Tolay Fault would be crossed again on Highway 116. The Tolay fault is a Quaternary feature and it is

not considered potentially active. The risk of surface rupture is low and would be confirmed by trenching along the alignment where it would cross the fault.

From the treatment plant to Highway 116 (about 21 miles), only 6 miles of the alignment is not in alluvium. Maximum depths of alluvial deposits vary from 50 to 300 feet. Slopes are low, but fairly unstable throughout this portion of the route. East of the junction with Lakeville Road, slopes are very unstable. Groundshaking hazards would originate along the Rodgers Creek fault zone less than 3 miles east of the Lakeville Road junction.<sup>52</sup>

Following Lakeville Road the alignment would cross no more faults. However, it would be in an area of very deep alluvium (maximum depth about 300 feet). Also, the alignment would transverse at least 10 miles of younger Bay mud as much as 100 feet thick. The Bay mud is not capable of providing foundation support for heavy structures and would need to be engineered to adequately support the pipe line during earthquake-induced groundshaking. Bay mud reacts violently to groundshaking because of its semi-liquid state. It may wave, settle, liquefy, spread or lurch depending upon the seismic conditions. These reactions make it as unstable as landslide-prone slopes even though the deposit is flat-lying.<sup>53</sup>

### 9.3 IMPACTS AND HAZARDS OF WASTEWATER SYSTEM OPERATION

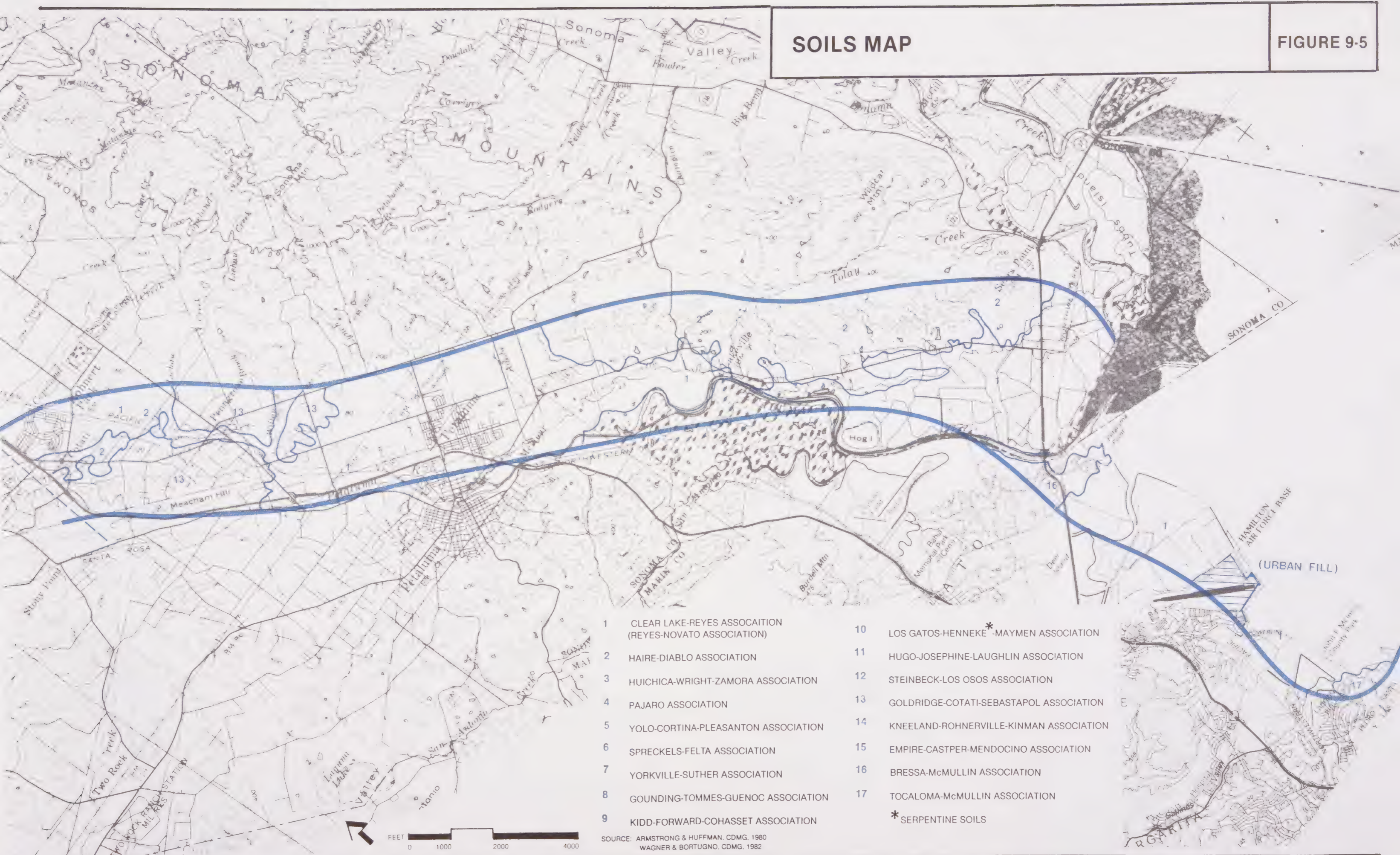
#### 9.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS

##### Impacts

Geothermal development reduces the pressure of fluids in the subsurface reservoir. This, in turn reduces the amount of steam and heat reaching the surface. The result is a gradual decline in the surface temperature of the area and a related decline in the area's capability as a viable source of energy. Injection of treated wastewater would replace about 20% of the water lost each year during power generation, thus prolonging the useful life of the developed part of the reservoir. There are potential problems if the water is not injected at the same location from which the steam was vaporized. Too much water injected to a small area of the reservoir may swamp the system, thereby blocking steam in nearby fractures from migrating to the surface generating facilities. Injected water may cause failure, through swelling or collapse, of the wallrock in drill holes or fractures, thus reducing or stopping steam production until the damaged zone can be cleared.<sup>54</sup>

# SOILS MAP

FIGURE 9-5



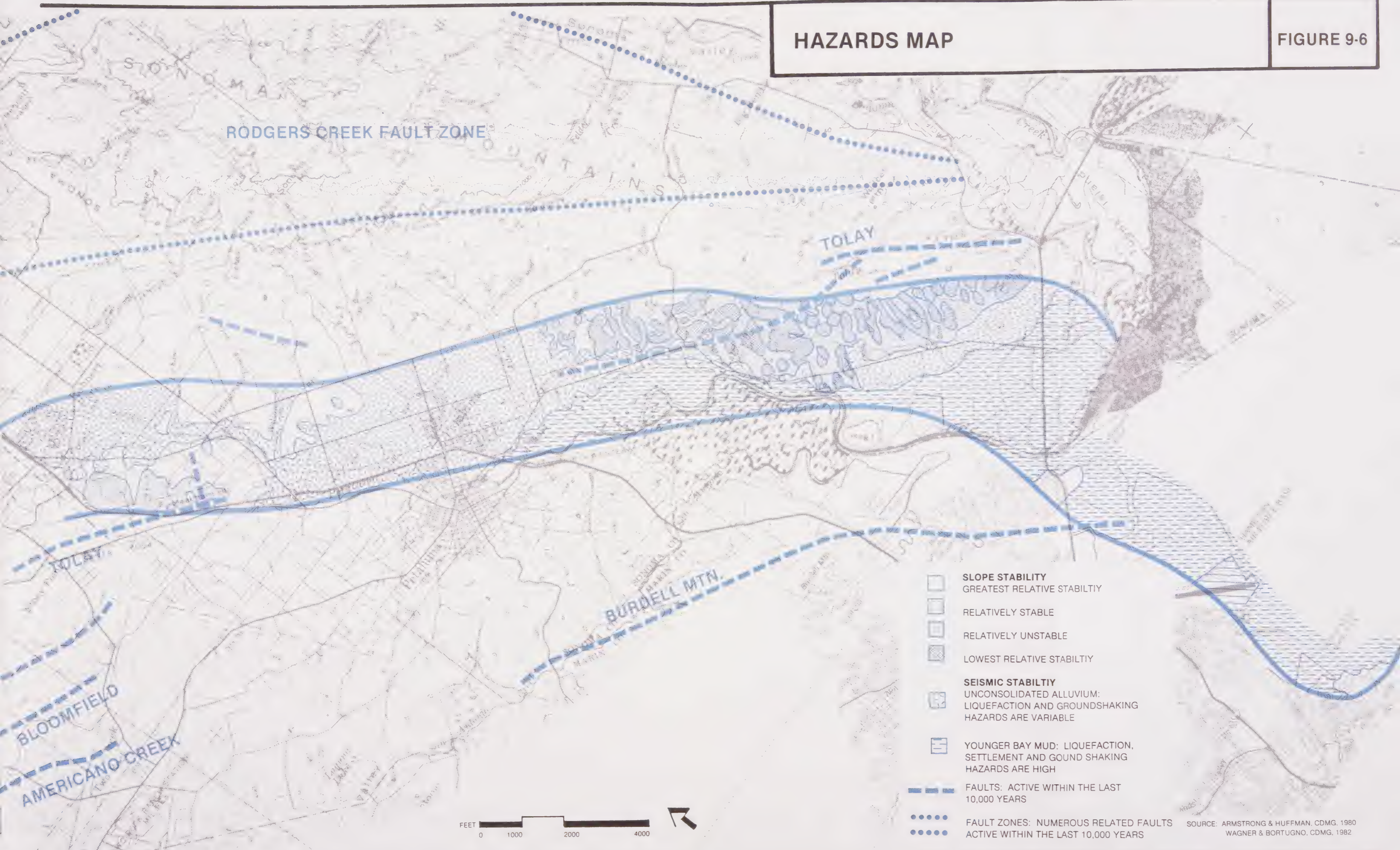
- |   |   |    |   |
|---|---|----|---|
| 1 | CLEAR LAKE-REYES ASSOCAITION (REYES-NOVATO ASSOCIATION) | 10 | LOS GATOS-HENNEKE * -MAYMEN ASSOCIATION |
| 2 | HAIRE-DIABLO ASSOCIATION                                | 11 | HUGO-JOSEPHINE-LAUGHLIN ASSOCIATION     |
| 3 | HUICHICA-WRIGHT-ZAMORA ASSOCIATION                      | 12 | STEINBECK-LOS OSOS ASSOCIATION          |
| 4 | PAJARO ASSOCIATION                                      | 13 | GOLDRIDGE-COTATI-SEBASTAPOL ASSOCIATION |
| 5 | YOLO-CORTINA-PLEASANTON ASSOCIATION                     | 14 | KNEELAND-ROHNERVILLE-KINMAN ASSOCIATION |
| 6 | SPRECKELS-FELTA ASSOCIATION                             | 15 | EMPIRE-CASTPER-MENDOCINO ASSOCIATION    |
| 7 | YORKVILLE-SUTHER ASSOCIATION                            | 16 | BRESSA-McMULLIN ASSOCIATION             |
| 8 | GOUNDING-TOMMES-GUENOC ASSOCIATION                      | 17 | TICALOMA-McMULLIN ASSOCIATION           |
| 9 | KIDD-FORWARD-COHASSET ASSOCIATION                       |    | * SERPENTINE SOILS                      |

SOURCE: ARMSTRONG & HUFFMAN, CDMG, 1980  
WAGNER & BORTUGNO, CDMG, 1982



# HAZARDS MAP

FIGURE 9-6





The relationship between steam production and induced seismicity is not completely understood, but it is known that the number of micro-earthquakes in the area of The Geysers has more than doubled since commercial production began, and is increasing. Injection is expected to prolong the production life of the field and, therefore, would be expected to prolong and increase the induced seismicity of the area. It is possible that the continued and increased activity would result in more landsliding in this region of relatively unstable slopes.<sup>55</sup>

The production of other commercial geologic resources in the area would not be altered by the injection, because injection would not occur beyond the lease holds of the operators. No other resources are developed in the area of geothermal production. Noncommercial uses, such as rock collecting, mountain climbing or fumarole viewing would not be subject to any further restrictions because of the injection project.<sup>56</sup>

Because the storage facilities at The Geysers would be sealed and the injection would take place far below the ground surface, there would be no effects on the soil during normal operation of the project. An accidental spill of stored water could cause soil erosion or mudslides if the breached pond were situated adjacent to a steep or unstable slope and did not have containment measures, such as diversion levees and auxiliary drains, built into the system. This also would be true for the water in the surge tanks at the pump stations along the pipeline. The storage ponds near Santa Rosa would present a lower risk of erosion during a pond wall failure because of the flat terrain and the relatively low erosion potential of the local soils. Because the system is still in the concept stage, only general comments can be made regarding to the erosion potential at the five pump station sites.

The risk of erosion from a break in the pipeline would vary with the location of the break and the amount of water that escaped from the system. Because the alignment would follow existing roadways there is less possibility of breaks occurring in areas of sensitive soils. The pipe would be laid in an engineered-backfilled trench cut in compacted subsoil or bedrock (except at major river crossings). These natural materials have levels of erosion hazard varying from low to very high.

They also have a variety of different landslide potentials, most of which are fairly high in areas other than the Santa Rosa Plain, that reflect the likelihood of water-saturation induced landsliding (Figure 9-4). A pipeline break and subsequent escape of water in a steep or otherwise unstable area could saturate slide-prone soil or rock, generating damaging slides or mudflows.

### Hazards

Environmental geologic or soil factors that could affect the injection alternative include seismic groundshaking, surface faulting, landsliding and volcanic eruption. The micro-seismicity at The Geysers is not of sufficient magnitude to be of concern, however, a maximum credible earthquake on one of the major faults, as previously discussed, could damage the treatment, transportation, storage or injection facilities. Pipelines could be ruptured; tanks ruptured, displaced from their foundations or overturned; pond levees breached or liners cracked; transmission or injection pumps displaced; wells collapsed.<sup>57</sup> The most likely occurrence would be a local or regional power failure. Each of these events could create sufficient damage in part or all of the system to cause a shutdown of the operation while repairs were made. The environmental effects of such damage are discussed in the Impacts section above.

Surface faulting would affect only a narrow strip of land along the trace of an active fault. Many faults of various states of activity cross The Geysers. The location of any part of the facilities astride one of these traces could result in damage from local fault activity that otherwise would not occur. Damages similar to those expected from destructive earthquakes along major regional faults may be caused by much smaller earthquakes on local faults, if structures have been built without regard for the location of active traces.<sup>58</sup>

Landsliding, either caused by earthquakes or by static slope instability, is probably the most common hazard in the geothermal area. Facilities may be buried by landslide debris from upslope, pulled apart by loss of support as landslide debris falls downslope from facility foundations, or sheared off by subsurface shift of landslide blocks. Wells and buried pipelines are particularly susceptible to subsurface shear.<sup>59,60</sup>

Volcanic eruption is not considered likely at The Geysers, although the possibility exists at any active geothermal site. The center of volcanism that produced The Geysers was relatively active between 55,000 and 10,000 years ago. The center of activity appears to have been moving north for the last 10,000 years and has become much less active in the entire area.<sup>61</sup>

### Mitigations

The operation of the injection system would be supervised by trained personnel, familiar with reservoir engineering techniques and the current reliable literature on injection theory and procedure. This would provide maximum protection for the resource and its associated geological environment.

Identified faults would be monitored for continued or renewed earthquake activity. Appropriate preparations, in the form of an earthquake emergency response plan, would be made (see below).

Identified areas of very steep slopes and existing landslides would be monitored for renewed activity caused by injection-induced micro-seismicity. Reconstruction of slopes would take place as necessary.

A detailed Permanent Erosion and Sedimentation Control Plan<sup>62</sup> would be prepared by the project engineer for the injection alternative, and would be submitted for review and approval by the County. The specific language of such plans varies, but the concepts to be adhered to include the following:

- o Locating structures outside major streams and drainageways.
- o Discharging project runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.
- o Keeping storm water runoff velocities low.
- o Trapping sediment before it leaves the site with such techniques as check dams, sediment ponds, or siltation basins.
- o Minimizing disturbed areas.
- o Stabilizing disturbed areas, either by vegetative or mechanical methods.

A detailed Earthquake Preparedness Plan<sup>63</sup> would be prepared by the project operator for the injection alternative, and would be submitted for review and approval by the County. The specific language of such plans varies, but the concepts to be adhered to include the following:

- o Ensuring existing and proposed seismic designs meet current County, State and Federal standards, where applicable.
- o Making structural and non-structural elements secure from the effects of expected levels of groundshaking.
- o Assigning specific personnel primary and back-up responsibilities to be carried out during a seismic emergency.
- o Providing supplies of emergency water, food and shelter for project personnel to remain on-site for at least 3 days.
- o Providing training for personnel in First Aid, CPR and other emergency response procedures.
- o Carrying out practice drills of emergency response procedures.

### 9.3.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

#### Impacts

The operation of rapid infiltration systems carries the potential danger of soil saturation with subsequent mudsliding. Saturation could result from excessive application of water, faster than it could be filtered and discharged. The soils at the proposed site are not especially erosion-prone. The percolation rates generally are moderate to very rapid, indicating that they probably would not become saturated rapidly during operation of the system. However, should they become saturated, the sides of the ponds could slump or slide, even though the dry soil strengths are fair to good.<sup>64</sup>

Tanks and storage ponds at the plant site could be a potential source of erosion if they were breached. However, because the topography is flat, the soils are not erosion-prone and the ponds have containment systems in place, this is not considered a major factor.

The underlying geologic formation, the Glen Ellen, is water-bearing and is buried at depths of 25 to 60 feet by water-bearing alluvium.<sup>65</sup> The added amounts of water that would reach this formation from the rapid infiltration site would be small, because the

rapid percolation through the alluvial would be picked up by the river's hydrologic system before it could reach the static water table.

### Hazards

The only major environmental geologic or soil factor that could affect the year-round river disposal alternative is seismic groundshaking. As described for Alternative 1, the structural portions (buildings, reservoirs and pipes) of the facilities could be damaged, displaced or destroyed by a major earthquake on one of the active faults in the region. The rapid infiltration ponds might be damaged by minor landslips during such an event, but a more likely occurrence would be the distortion and shearing of the pipes that would deliver treated water to the ponds. The environmental effects of such damage are discussed in the Impacts section above.<sup>66</sup>

### Mitigations

The operation of the rapid infiltration system would be supervised by trained personnel, familiar with hydraulic engineering techniques and the current reliable literature on flow design and procedure. This would provide maximum protection for the soils associated with the alignment and the pond areas.

A detailed Permanent Erosion and Sedimentation Control Plan would be prepared by the project engineer for the erosion-prone areas (few though they might be) that could be effected by the year-round river disposal alternative, and would be submitted for review and approval by the County. The concepts to be included in the plan are outlined in the mitigations for Alternative 1.

A detailed Earthquake Preparedness Plan would be prepared by the project operator for the year-round river disposal alternative, and would be submitted for review and approval by the County. The concepts to be included are outlined in the mitigations for Alternative 1.

### 9.3.3 ALTERNATIVE 3: OCEAN DISPOSAL

#### Impacts

Normal operation of this alternative would have no effect on the soils or bedrock at the treatment plant, in the Laguna area or along the transport alignment. The possibility of sub-marine erosion at the outfall would be eliminated by the diffuser employed to promote mixing of treated water and ocean water. The risk of erosion from a pond or tank spill would be similar to that previously described for Alternative 2. The risk of landslides from a break in the pipeline would not be as severe as that described for Alternative 1, because the terrain through which the alignment would pass is not so steep. The risk of erosion from such a break, however, would be similar, because of the locally high erosion potential of some of the soils west of the Laguna.

#### Hazards

Environmental geologic or soil factors that could affect the ocean disposal alternatives include seismic groundshaking, surface faulting, and landsliding. A maximum credible earthquake on one of the major faults, as previously discussed, could damage the storage, treatment, transportation, or outfall facilities. Pipelines could be ruptured; tanks ruptured, displaced from their foundations or overturned; pond levees breached or liners cracked; transmission pumps displaced; outfall pipes or diffuser structures collapsed.<sup>67</sup> Each of these events could create sufficient damage in part or all of the system to cause a shutdown of the operation while repairs were made. The environmental effects of such damage are discussed in the Impacts section above. In addition, some amount of sub-marine erosion would be expected while the system drained, if the diffuser were damaged or destroyed.

#### Mitigations

The operation of the ocean disposal system would be supervised by trained personnel, familiar with hydraulic engineering techniques and the current reliable literature on pipeline transport design and procedure. This would provide maximum protection for the plain-, river- and ocean-related soil environments associated with each portion of the project.

Identified faults would be monitored for continued or renewed earthquake activity. Appropriate preparations, in the form of an earthquake emergency response plan, would be made (see below).

Identified areas of very steep slopes and existing landslides would be monitored for renewed activity. Reconstruction of slopes would take place as necessary.

A detailed Permanent Erosion and Sedimentation Control Plan would be prepared by the project engineer for the erosion-prone areas downstream that could be effected by accidental spills caused by pipeline ruptures, and submitted for review and approval by the County. The concepts to be included in the plan are outlined in the mitigations for Alternative 1. Emergency procedures also would be included to deal with the potentially damaging effects of a spill at one of the reservoirs.

A detailed Earthquake Preparedness Plan would be prepared by the project operator for the ocean disposal alternative, and would be submitted for review and approval by the County. The concepts to be included are outlined in the mitigations for Alternative 1.

### 9.3.4 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

#### Impacts

This alternative would have effects nearly identical to those of Alternative 3. The potential for landslides and erosion, however, generally would be lower because of the level terrain and the fine-grained erosion-resistant soils.

#### Hazards

The hazards to this alternative would be nearly identical to those for Alternative 3. The potential for fault rupture would be considerably less because the Bay disposal alignment would not cross the San Andreas Fault. Groundshaking, and subsequent damage from landsliding, however, would be similar along those sections of the alignment that pass through steep terrain. It would be less in the areas of level terrain and the fine-grained erosion-resistant soils.

### Mitigations

The operation of the Bay disposal system would be nearly identical to the operation of an ocean disposal system, as described for Alternative 3b. The mitigations for Alternative 3b. would apply equally to the Bay disposal alternative.

## **9.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION**

### **9.4.1 ALTERNATIVE 1: REUSE AT THE GEYSERS**

#### Impacts

This alternative would include the physical expansion of the treatment plant, the construction of storage ponds and/or tanks near Santa Rosa and at The Geysers, the construction of a pipeline with secondary pump stations to The Geysers, and the drilling of injection wells at The Geysers. All the construction would necessitate the disruption of some natural surface soils, except for the construction of the pipeline which would be laid in existing roadbeds. The soil disruption and recompaction would be necessary to develop suitable foundation support for the above-ground structures (plant buildings, pump stations, storage tanks, drilling platforms) and to excavate to appropriate depths the in-ground structures (ponds, levee bases).

Erosion of exposed soils would be a potential impact, even in the construction within the roadways. Stock-piled soil or backfill would be subject to washing off the alignment or construction site during rainfall. Walls of open excavations would be subject to washout or collapse, not only from rainwater, but also from groundwater pumped out of the excavation if the water table were intersected by the digging. Water used during drilling, if it were allowed to escape, also could become a potential source of erosion.

Drilling and dewatering operations also have the potential to induce mudflowing or landsliding by allowing water to escape from the work site into the surrounding soil. Depending on the locations selected for the pump stations, there would be the possibility of generating new slope instability or aggravating existing slope instability if supporting soils were removed from the base of a landslide-prone hillside. Additionally, the location of the existing roads to The Geysers is through landslide-prone terrain, as shown on Figure 9-4. During field inspections in April 1986, numerous road collapses were noted, the largest of which were being repaired.<sup>68</sup> New construction along these routes could be

responsible for increasing the amount of slope instability on them by undercutting supporting soils or rock formations.

It is unlikely that the construction would have any adverse effects on the bedrock, other than that previously mentioned with regard to landslide generation. A possible exception could occur during the drilling of the injection wells. The vibration caused by the drilling could dislodge loose rock in the vicinity of the work-site, producing rockfalls or local landslides. The possibility also exists that the steam reservoir itself could be damaged by drilling the injection wells. Interconnections within the reservoir could be opened or closed, by the drilling operation, that would reduce the capability to produce developable steam. This is a risk common to all geothermal operations of this type and must be accepted as part of the business of developing the resource.<sup>69</sup>

### Hazards

The system would be exposed to several major and minor geologic or soil hazards during the construction period. The most significant hazard would be that posed by earthquakes. As indicated in previous descriptions of seismically related impacts, groundshaking effects could disrupt or destroy the system during its operation if appropriate seismic design were not included in the construction of the project. This means that each building and reservoir must be designed to withstand expected vibration from earthquakes along the major faults in the region; the pipelines must be sufficiently flexible and must have adequate realignment mechanisms for crossing the fault traces to reduce the possibility of shearing to a minimum; and the most recent reliable sources of information must be used in selecting the locations for injection wells.

Surface faulting, landsliding and volcanism, as discussed for operational hazards, would have similar effects on the construction stage of the project. Additionally, such soil related hazards as high expansiveness, high compressibility, low shear strength and low permeability would affect the design of the foundations and the safety of the excavations for each component of the system. Improperly founded and drained structures would not be expected to perform well under typical seismic and static stability conditions for the area. Weak or saturated supporting soils can cause unacceptable amounts of settlement even without the added stresses of seismic loading. The effects can range from the nuisance level (sticking doors and windows) to the major structural damage level (shifted

or collapsed foundations). Combined with seismic loads, the effect could be sufficient to make the difference between survival and destruction of a component of the system.

### Mitigations

Identified areas of very steep slopes and existing landslides would be avoided wherever possible.

Standards for construction pad grading would meet or exceed those necessary to locate structures on slopes steeper than 15%.

Known active or potentially active faults have been identified and construction would be avoided in those areas, wherever possible.

Buildings, pipelines and reservoirs would be designed to meet the current standards of the Seismology Committee of The California Structural Engineers Association.<sup>70</sup> Designs would include such concepts as the use of flexible joints or re-alignment sections to cross fault zones, cross-bracing and reinforced concrete in structures that could be damaged by groundshaking, and the securing of non-structural elements (such as pumps or other heavy equipment) to prevent shifting during earthquake-induced ground motion.

The construction plan would adhere to the recommendations of a Geotechnical Report prepared for the Injection Alternative. Recommendations would include site-specific information for the repair of landslides, weak soils, areas of soil creep and potentially unstable slopes in the alignments or near developed property. The types of information and recommendations sought would be similar to the following list.

- o All grading and site preparation would be done under the direct observation of the soil engineer in accordance with the guide specifications for engineered fill supplied by the geotechnical consultant.
- o Weak soils (expansive, compressible, liquefaction-prone) would be over-excavated and replaced with sound material properly keyed and compacted.
- o Fill slopes and cut slopes would be inclined no greater than 2:1 unless specifically reviewed and approved by a qualified engineering geologist. Subdrainage and surface drainage should be installed to prevent sloughing or raveling of slopes.

- o Storm drainage and subdrainage would be installed and maintained to prevent erosion of fill.
- o High fill slopes would be over-filled and graded back to well-compacted material to obtain stable surfaces.
- o Cut-and-fill slopes would be planted to reduce erosion.
- o Foundations suited to soil conditions would be used for all structures.
- o Retaining walls would be well-drained and designed to resist pressures appropriate to the size of the backslope.
- o After construction sites were graded they would be inspected for expansive soils and rock by a qualified engineer and treated where necessary according to his recommendations.
- o Landslides would be repaired by over-excavation, installation of subdrains and engineered backfill.

Whenever possible, the period of heavy construction, when soils are exposed, would be limited to the time of year when rainfall is minimum -- June through September. Temporary dikes, sedimentation basins, drainage ditches and diversion ditches would be used to control and prevent damage from storm drainage in construction areas. Following construction, either artificial or vegetative cover would be provided for exposed soils until appropriate natural cover could develop.

The construction sites would be designed to increase the time of stormwater runoff concentration through grading, detention areas, energy dissipaters, moderate flow velocities, and so forth.

A detailed Temporary Erosion and Sedimentation Control Plan<sup>71</sup> for the construction period would be prepared by the project engineer and submitted for review and approval by the County. The specific language of such plans varies, but the concepts to be adhered to include the following:

- o Locating staging areas outside major streams and drainageways.
- o Keeping slope lengths and gradients to a minimum.
- o Discharging construction runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.

- o Minimizing disturbed areas.
- o Keeping runoff away from disturbed areas during construction.
- o Stabilizing disturbed areas as quickly as possible, either by vegetative or mechanical methods.
- o Keeping storm water runoff velocities low.
- o Trapping sediment before it leaves the site with such techniques as check dams, sediment ponds, or siltation basins.

#### 9.4.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

##### Impacts

Year-round disposal to the Russian River would include the physical expansion of the treatment plant and the construction of about 100 acres of rapid infiltration facilities. The disruption of surface soils caused by plant expansion would be similar to that described for Alternative 1. The construction of the rapid infiltration ponds would involve some excavation and recontouring of existing alluvial plains to accommodate the systems and the construction of a pipeline to deliver treated water to the ponds.

Erosion of exposed soils, potential excavation wall collapse and the possibility of generating mudslides were discussed for Alternative 1. Because of the flatter terrain involved in Alternative 2 the risks would be correspondingly lower, although not totally eliminated.

##### Hazards

As described for Alternative 1, the most significant hazard would be posed by earthquakes. The risks to buildings and reservoirs would be the same as for Alternative 1. The risks to pipelines would be more limited because (1) fewer miles of line would be needed to connect the existing system at the plant with the proposed rapid infiltration ponds, and (2) the terrain crossed by the lines is more stable than that toward the north end of the lines for Alternative 1. Surface faulting and landsliding would be minimal problems because of the location of the plant and ponds away from major faults and on the level Russian River plain. A short length of pipeline would be affected by the Healdsburg Fault in a fashion similar to that described for Alternative 1. The soil

related hazards of high expansiveness, high compressibility, low shear strength and low permeability would affect the design of the foundations and the safety of the excavations in the same way as described for Alternative 1.

### Mitigations

Buildings, pipelines and reservoirs would be designed to meet the current standards of the Seismology Committee of The California Structural Engineers Association. Designs would include the concepts outlined in the mitigations for Alternative 1 to prevent damage during earthquake-induced ground motion.

The construction plan would adhere to the recommendations of a Geotechnical Report prepared for the indirect river disposal alternative. Recommendations would include site-specific information for the repair of weak soils along the pipelines, in the reservoir areas and near developed property. The type of information and recommendations sought are outlined in the mitigations for Alternative 1.

A detailed Temporary Erosion and Sedimentation Control Plan for the construction period would be prepared by the project engineer and submitted for review and approval by the County. The specific concepts to be included are outlined in the mitigations for Alternative 1.

Whenever possible, the period of heavy construction, when soils are exposed, would be limited to the time of year when rainfall is minimum -- June through September. Temporary erosion and sedimentation controls as outlined for Alternative 1 would be used to prevent damage from storm drainage in construction areas.

### 9.4.3 ALTERNATIVE 3: OCEAN DISPOSAL

#### Impacts

This alternative would include the physical expansion of the treatment plant and the construction of a pipeline, possibly with one transmission pump station, to an outfall off the Russian River or Salmon Creek. The construction would necessitate the disruption of natural surface soils, as discussed for Alternative 1. The construction of the pipeline would follow existing road beds, except at the outfall of either the north or south route, and on the leg east of Graton along the north route.

Erosion of exposed soils, either in stock piles or open excavations would be similar to that discussed for Alternative 1. Drilling would not be involved, and the terrain would be slightly less rugged than for Alternative 1, but the potential to induce mudflowing or landsliding by allowing water to escape from the work site into the surrounding soil would still exist. The construction of the outfall pipes through either of the estuaries could have serious erosion risks. Because of the loose, coarse-grained soils and the proximity of river and ocean currents that would be disrupted by temporary revetments, there is the possibility that soils could be washed away from present areas for sedimentation and redeposited at other localities. The potential for erosion at staging areas, at pipe storage areas and from the movement of construction equipment is very high in these sandy soils unless appropriate erosion control techniques are maintained throughout the construction period.

Depending on the location selected for the pump station, the possibility of increasing local slope instability would be as described for Alternative 1.

Both routes to the ocean are through landslide-prone terrain, as shown on Figure 9-3. New construction along these routes could be responsible for increasing the amount of slope instability on them by undercutting supporting soils or rock formations.

It is unlikely that the construction would have any adverse effects on the bedrock, other than that previously mentioned with regard to landslide generation.

### Hazards

The system would be exposed to major and minor geologic or soil hazards during the construction period, as discussed for Alternative 1. The most significant hazard would be that posed by earthquakes. As indicated in previous descriptions of seismically-related impacts, groundshaking effects could disrupt or destroy the system during its operation if appropriate seismic design were not included in the construction of the project. These effects were described for Alternative 1 and would be similar for this alternative. Although the terrain toward the coast is not so rugged as that toward The Geysers, it is slide-prone and active faults would be crossed. Additionally, the outfall and diffuser would have to be designed to withstand major earthquake activity on the San Andreas Fault because they would be located in the fault zone.

### Mitigations

Identified areas of very steep slopes and existing landslides would be avoided wherever possible.

Standards for construction pad grading would meet or exceed those necessary to locate structures on slopes steeper than 15%.

Known active or potentially active faults have been identified and construction would be avoided in those areas, wherever possible.

Buildings, reservoirs, pipelines and outfall/diffusers would be designed to meet the current standards of the Seismology Committee of The California Structural Engineers Association. Designs would include the concepts outlined in the mitigations for Alternative 1 to prevent damage during earthquake-induced ground motion. Additionally, the possibility of relocating the diffuser outside the San Andreas Fault Zone would be investigated. There is no guarantee that such relocation would be feasible or warranted.

The construction plan would adhere to the recommendations of a Geotechnical Report prepared for the Ocean Disposal Alternative. Recommendations would include site-specific information for the repair of landslides, weak soils, areas of soil creep and potentially unstable slopes in the alignments or near developed property. The types of information and recommendations sought are outlined in the mitigations for Alternative 1.

A detailed Temporary Erosion and Sedimentation Control Plan for the construction period would be prepared by the project engineer, and would be submitted for review and approval by the County. The specific concepts to be included are outlined in the mitigations for Alternative 1.

Whenever possible, the period of heavy construction, when soils are exposed, would be limited to the time of year when rainfall is minimum -- June through September. Temporary erosion and sedimentation controls as outlined for Alternative 1 would be used to prevent damage from storm drainage in construction areas.

#### 9.4.4 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

##### Impacts

This alternative would have effects nearly identical to those of Alternative 3. The potential for landslides and erosion, however, generally would be lower because of the level terrain and the fine-grained erosion-resistant soils along most of the alignment.

The construction of the pipeline south of Highway 37, the outfall pipe in Los Gallinas estuary and the diffuser in San Pablo Bay would be complicated by the presence of the younger Bay mud. Unless the construction techniques and the foundations for the pipeline, outfall and diffuser were designed to place no new pressure on the mud, there would be the probability of generating lateral displacements in the mud. The magnitude and significance of this effect could vary depending on the depth of the mud and the amount of load placed on it.

##### Hazards

The land-based hazards to construction of this alternative would be nearly identical to those for Alternative 3. The soil hazards in the Santa Rosa Plain would be just as described for an ocean disposal plan. The potential for fault rupture would be considerably less because the Bay disposal alignment would not cross the San Andreas Fault. Groundshaking, and subsequent damage from landsliding, however, would be similar along those sections of the alignment that pass through steep terrain. It would be less in the areas of level terrain and the fine-grained erosion-resistant soils.

The hazards of construction on Bay mud are well known in the San Francisco Bay Area. The upper deposit of mud contains such a large quantity of water that it cannot support much more than its own weight without extensive drying and engineering. The lower deposit of mud is considerably stiffer and much less compressible. The mud is underlain by a competent sand formation that is capable of providing adequate support for structural foundations. The common effect of building on mud is differential settlement, often sufficient to destroy foundations and the structures they support. The usual mitigation is to fill the site, prior to building, with enough material to provide foundation support and to compensate for the total amount of anticipated settlement that results from the weight of the fill.

### Mitigations

The mitigations to the land-based construction impacts and hazards of this alternative would be nearly identical to those for Alternative 3. The soil-related mitigations in the Santa Rosa Plain would be just as described for an ocean disposal plan. The measures needed for the potential effects of fault rupture would be less severe because the Bay disposal alignment would not cross the San Andreas Fault. Protection from groundshaking, and subsequent damage from landsliding, however, would be similar along those sections of the alignment that pass through steep terrain. It would be less in the areas of level terrain and the fine-grained erosion-resistant soils.

For construction on Bay mud, it would be necessary to determine the thickness and distribution of the deposits along the portions of the alignment south of Highway 37. A design for the pipeline, the outfall and the diffuser then would be selected to respond to the needs established by the mud investigation. For example, in areas where the mud was very shallow, it might be advisable to displace the mud completely with engineered fill. Where the mud was thicker, a pad of "floating" fill might be more appropriate, or piles might be used to penetrate the mud and reach competent supporting soils beneath it.

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<sup>2</sup>Wagner, D.L., and E.J. Bortugno, Santa Rosa Quadrangle, California Division of Mines and Geology, Regional Geologic Map Series, No. 2A (Geology), 1982, sheets 1 & 5, scale 1:250 000.

<sup>3</sup>Wagner, D.L., and E.J. Bortugno, Geology of the Santa Rosa Quadrangle, California Geology, 1983, volume 36, number 12, pages 257-280.

<sup>4</sup>Hinson, J.C., D.R. Huffman and G. Troughton, Geologic Study of the Bennett Valley Area, 1872.

<sup>5</sup>Wagner and Bortugno, 1983, op.cit.

<sup>6</sup>Wagner and Bortugno, 1983, op.cit.

<sup>7</sup>Wagner and Bortugno, 1983, op.cit.

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- <sup>12</sup> Fricke, H. Environmental Resources Assessment, Santa Rosa Long-Term Study, Phase I, Technical Memorandum, Number T16, CH2M Hill, Santa Rosa, February 14, 1986, pages 2-7.
- <sup>13</sup> Fricke, February 1986, op.cit.
- <sup>14</sup> Huffman, M.E. and C.F. Armstrong, Geology for Planning in Sonoma County, California Division of Mines and Geology, Special Report 120, 1980, 31 pages, 5 plates, map scale 1:62 500.
- <sup>15</sup> Soil Conservation Service, 1972, op.cit.
- <sup>16</sup> Fricke, H., Geysers Injection Alternatives, Santa Rosa Long-Term Study, Phase I, Technical Memorandum Number T10, CH2M Hill, Santa Rosa, January 28, 1986.
- <sup>17</sup> California Energy Commission, Final EIR for PG&E Co., Geysers 17 Geothermal Power Unit, Sonoma county, California, SCH No. 78122557, August 22, 1979, pages 21-34, 78-94.
- <sup>18</sup> Huffman, M.E., Geology for Planning on the Sonoma County Coast Between the Russian and Gualala Rivers, California Division of Mines and Geology, Preliminary Report 16, 1972.
- <sup>19</sup> Soil Conservation Service, 1972, op.cit.
- <sup>20</sup> Wagner and Bortugno, 1983, op.cit.
- <sup>21</sup> Huffman and Armstrong, 1980, op.cit.
- <sup>22</sup> Huffman and Armstrong, 1980, op.cit.

- <sup>23</sup> Soil Conservation Service, 1972, op.cit.
- <sup>24</sup> Soil Conservation Service, 1985, op.cit.
- <sup>25</sup> Richter Scale: a logarithmic scale developed in 1935 by Charles Richter to measure earthquake magnitude by the energy released, as opposed to earthquake intensity as determined by local effects on people, structures, and earth materials.
- <sup>26</sup> Greensfelder, R.W., "Seismicity, Groundshaking and Liquefaction Potential," in: M.E. Huffman and C.F. Armstrong, Geology for Planning in Sonoma County, California Division of Mines and Geology, Special Report 120, 1980, pages 5-14.
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- <sup>29</sup> R.W. Greensfelder, Maximum Credible Rock Acceleration from Earthquakes in California, California Division of Mines and Geology, Map Sheet 23, 1974, scale 1:2 500 000.
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- <sup>31</sup> Greensfelder, 1980, op.cit.
- <sup>32</sup> Huffman and Armstrong, 1980, op.cit.
- <sup>33</sup> Greensfelder, 1980, op.cit.
- <sup>34</sup> Huffman and Armstrong, 1980, op.cit.
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- <sup>38</sup> Soil Conservation Service, 1972, op.cit.
- <sup>39</sup> Soil Conservation Service, 1985, op.cit.

<sup>40</sup>Huffman and Armstrong, 1980, op.cit.

<sup>41</sup>Huffman and Armstrong, 1980, op.cit.

<sup>42</sup>Fricke, January 1986, op.cit.

<sup>43</sup>Huffman and Armstrong, 1980, op.cit.

<sup>44</sup>Jennings, 1975, op.cit.

<sup>45</sup>The State of California has delineated Special Studies Zones around active and potentially active faults in the state. The zones extend about 700 feet on either side of identified fault traces. No structures for human occupancy may be built across an identified active fault trace. An area of 50 feet on either side of an active fault trace is assumed to be underlain by the fault, unless proven otherwise. Proposed construction within the Special Studies Zone can take place only following the completion of a geological report prepared by a California Registered Geologist.

<sup>46</sup>Huffman and Armstrong, 1980, op.cit.

<sup>47</sup>Huffman and Armstrong, 1980, op.cit.

<sup>48</sup>Huffman and Armstrong, 1980, op.cit.

<sup>49</sup>Greensfelder, 1974, op.cit.

<sup>50</sup>Huffman, 1973, op.cit.

<sup>51</sup>Jennings, 1975, op.cit.

<sup>52</sup>Huffman and Armstrong, 1980, op.cit.

<sup>53</sup>Geologic and Engineering Aspects of San Francisco Bay Fill, H.B. Goldman, Editor, California Division of Mines and Geology, Special Report 97, San Francisco, California, 1969, 130 pages, 4 plates, map scale 1:79 200.

<sup>54</sup>Fricke, January 1986, op.cit.

<sup>55</sup>California Energy Commission, 1979, op.cit.

<sup>56</sup>California Energy Commission, 1979, op.cit.

- <sup>57</sup>R.D. Borchardt, et.al., Maximum Earthquake Intensity Predicted on a Regional Scale, U.S. Geological Survey, Miscellaneous Field Investigations Map MF-709, 1975, scale 1:125 000.
- <sup>58</sup>California Energy Commission, 1979, op.cit.
- <sup>59</sup>California Energy Commission, 1979, op.cit.
- <sup>60</sup>Fricke, January 1986, op.cit.
- <sup>61</sup>California Energy Commission, 1979, op.cit.
- <sup>62</sup>Association of Bay Area Governments (ABAG), Manual of Standards for Erosion and Sedimentation Control Measures, Berkeley, revised, June 1981.
- <sup>63</sup>Red Cross Disaster Resource Center, Corporate Disaster Planning Guide, Golden Gate Chapter, American Red Cross, San Francisco, 1986.
- <sup>64</sup>Soil Conservation Service, 1972, op. cit.
- <sup>65</sup>Huffman and Armstrong, 1980, op.cit.
- <sup>66</sup>Greensfelder, 1974, op.cit.
- <sup>67</sup>Greensfelder, 1974, op.cit.
- <sup>68</sup>G.J. Burwasser, Geologist, EIP Associates, field reconnaissance, 16 to 18, April 1986.
- <sup>69</sup>California Energy Commission, 1979, op.cit.
- <sup>70</sup>Seismology Committee, Structural Engineers Association of California, Recommended Lateral Force Requirements and Commentary, San Francisco, California, 4th Edition, revised 1980.
- <sup>71</sup>ABAG, 1981, op.cit.





# HISTORY & ARCHAEOLOGY



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## 10 HISTORY AND ARCHAEOLOGY

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### 10.1 INTRODUCTION

The proposed project and its alternatives have the potential to affect archaeological and historical resources during construction activity. Pursuant to the California Environmental Quality Act, guidelines have been established pertaining to the preservation of known and discovered cultural resources that may be affected by proposed projects.

### 10.2 SETTING

The study area was inhabited in prehistoric times by the Pomo, Wappo and Miwok peoples. These indigenous groups lived in village communities with ample food supplies. European settlement in Sonoma County did not occur until 1812, when Russian seal and sea otter hunters leased a coastal village site from the Pomo Indians, thus establishing Fort Ross. Disturbed by the presence of non-Mexicans in their territory, the newly independent Mexican government in 1824 established Mission San Francisco de Solano, at present day Sonoma, to protect its interests in the North Bay. However, non-Mexican settlement was not limited to the Russians. Cyrus Alexander operated a tannery in the valley which now bears his name; Captain Henry Delano Fitch had been granted the Sotoyome Rancho near Healdsburg; and Samuel Smith arrived in 1843 with the first steam engine in California and erected a sawmill on the site of a Russian farm at present-day Bodega.<sup>1</sup>

### 10.3 IMPACTS OF WASTEWATER SYSTEM OPERATION

Operation of the alternative wastewater management systems would not be expected to affect historic and cultural resources.

## 10.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION

### ALTERNATIVE 1: REUSE AT THE GEYSERS<sup>2</sup>

#### Impacts

Alternative 1 involves transporting treated effluent to the Geysers by pipeline. The excavation would be approximately 6 feet wide by 8 feet deep. The route would generally follow the highway right-of-way with construction usually occurring in previously disturbed soil. Adjacent to this alignment are Sonoma County landmarks, the Cyrus Alexander Adobe and Cemetery and the Cyrus Alexander School. Implementation of this alternative would not affect these historic landmarks.

Eleven known archaeological sites have been recorded in proximity to this corridor and range from scatters of obsidian flakes to temporary campsites. The presence of these sites indicate the high archaeological sensitivity of the area and the possibility of encountering resources during construction activity.

#### Mitigation Measures

The following mitigation measures are suggested.

- o When a final pipeline route has been determined, an archaeologist should be hired to complete a thorough record survey and surface/subsurface testing program if appropriate.
- o In the event that unanticipated cultural resources are encountered within the project site during the course of construction, it is recommended that all earthmoving activity in the area of impact cease until the project sponsor retains the services of a qualified archaeological consultant, who shall examine the findings, assess their significance and offer recommendations for any procedures deemed appropriate to either further investigate and/or mitigate adverse impacts to those cultural resources which have been encountered.

### ALTERNATIVE 2: INDIRECT DISPOSAL TO THE RUSSIAN RIVER<sup>3</sup>

#### Impacts

Historic Sonoma County landmarks along this proposed alternative corridor include the Hicks House, Pitkin Ranch, Travis Ranch, Belden House and structures at Duncans Mills. Implementation of this alternative would not affect these structures.

Nineteen archaeological sites characterized generally as obsidian scatters or middens are located within or near the pipeline construction area or rapid infiltration system. Grading necessary to construct the rapid infiltration system and trenching for the pipeline may affect recorded and/or unknown resources.

#### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1.

### ALTERNATIVE 3: DISPOSAL TO PACIFIC OCEAN

#### Impacts<sup>4</sup>

Historic structures along or near this proposed alignment include the Gold Ridge Farm and the Hinds Hotel (both on the National Register of Historic Places), the Freestone House, Freestone School, the Witham House, the Watson School and Wayside Park and Stage Stop (County Landmarks), the Church of St. Teresa of Avila (California State Landmark) and the Town of Bodega Bay (California Inventory of Historic Places). These historic resources would not be affected by the implementation of this project.

Eighteen archaeological sites ranging from obsidian flakes and tools to occupation sites have been recorded in the proximity of the alternative indicating that this too is an area of high archaeological sensitivity. Although construction activity would often occur in previously disturbed soil, trenching required for placement of the proposed pipeline could affect archaeological resources.

#### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1.

### ALTERNATIVE 4: DISPOSAL TO SAN PABLO BAY

#### Impacts<sup>5</sup>

Located in proximity to this alternative are the Cotati Downtown Plaza (California Historical Landmark, California Inventory of Historic Places) and the Denman Creamery and Town of Penngrove (Sonoma County Landmarks). Ten archaeological sites

(shellmounds) have been recorded in the area with indication that several of these sites were excavated and destroyed during previous construction. The known archaeological sensitivity of this area indicates the possibility of encountering archaeological materials during placement of the pipeline.

#### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1.

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<sup>1</sup> Sonoma County Planning Department, Historic Preservation Program, Environmental Resources Management Element, Sonoma County General Plan, Technical Report, May, 1976.

<sup>2</sup> Brian J. Terhorst, Researcher, California Archaeological Inventory, Northwest Information Center, letter May 6, 1986, telephone conversation November 12, 1986.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> Ibid.



# RECREATION



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## 11 RECREATION

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### 11.1 INTRODUCTION

The proposed project and its alternatives could affect recreational uses of the Russian River, Laguna de Santa Rosa, San Pablo Bay and portions of the Sonoma County coastline. These areas support a number of developed recreational sites as well as serve as important water related recreational attractions in the Sonoma County region. The most significant recreational sites and activities associated with these areas are described in the setting section of this chapter.

Potential impacts include direct loss of habitat and recreational access to areas as a consequence of project operation and construction, and public health hazards as a result of water pollution. Of these two, the public health issue is potentially the more significant and is discussed in Chapter 7.

### 11.2 SETTING

#### 11.2.1 LAGUNA DE SANTA ROSA AND THE RUSSIAN RIVER

There are no County or City parks or privately developed recreational areas along the Laguna de Santa Rosa except for a limited amount of private and public hunting areas. The only open and easy public access points to the Laguna are at public road crossings. The principal recreation activities in this area are hunting, fishing, boating, and nature observation. Because of the limited access and lack of development, recreational use of the Laguna is rather limited.

The lower Russian River is commonly referred to as the River resort area. This stretch of the river is an important recreation resource to the San Francisco Bay region because of its mild summer climate, its scenic beauty, the adequate stream flows in the summer to

support the a variety of water contact sports, and its close proximity to the San Francisco Bay metropolitan area. The Russian River is a popular river for fishing, hunting, swimming, boating, hiking, horseback riding, sightseeing, and summer relaxation.

Fishing for salmon and steelhead is prohibited on the tributaries of the Russian River during the spawning season, November to about May 1. The California Department of Fish and Game does not have angler use records on the river, however, a conservative estimate is 6,000-8,000 angler days per year for steelhead fishing, which is the majority of fishing on the river. This use is expected to more than double in the next 5-7 years due to the planned expansions of the fish hatcheries on the River.

The principal wild game hunting in the area is for deer with some quail, dove and wild boar hunting as well. Reliable use figures for these activities are not available because most of the basin is in private ownership.

It is estimated that canoeing and river touring accounted for 25,000-50,000 user days per year on the River. These same projections indicated an increase in total visitation to the Russian River basin of an average of one million visitor days per year until the year 2010.

The other recreational activities are expected to account for approximately 75% of the total recreational use in the river basin. These activities include swimming, camping, picnicking, riding and hiking, and community activities such as fairs and cookouts.

### 11.2.2 COASTAL ZONE

#### State Parks

The California Department of Parks and Recreation is the administrating agency for the Sonoma Coast State Beaches. The Sonoma Coast State Beaches are composed of 19 units or beaches. Except for a few private land holdings, the majority of this stretch of coastline is within public ownership as shown in Figure 11-1. These beaches and river areas were included in the state park system because they contain natural features determined to be of high quality. The natural features of highest quality include; sand

# RECREATION AREAS

FIGURE 11-1





dunes, the Franciscan geologic formation, and three native plant and wildlife communities of limited distribution in the state including North Coast Scrub, Coastal Strand, and Coastal Saltmarsh. This stretch of coastline is also rich in Native American prehistoric sites as it is centered between the tribal territories of the Southwest Pomo Indians and the Coast Miwok Indians.

The primary recreational activities in these beaches and parks include hiking, picnicking, and fishing. Camping sites are provided at two of the beaches; Wright Beach and Bodega Dunes. Although some swimming occurs in the Russian River and Salmon Creek, very little swimming occurs in the ocean waters due to strong currents and low temperatures. Each beach and park has parking, restroom facilities, and a trail system. The busiest season is from June-August, when more than one-third of the year's total visitor-days are registered.

#### Private Resorts

There are three private resorts near the mouth of the Russian River; Lands End, Bridgehaven Campground, and Cassini Ranch Campground (see Figure 11-1). These resorts offer a variety of recreational opportunities including; fishing, camping, horseback riding, boating, and swimming. There is a private campground just north of the City of Bodega Bay, which is Cypress Dunes Campground.

#### County Parks

There are two Sonoma County Parks within this stretch of coastline, Westshore and Doran County Parks. Both of these parks are located near Bodega Harbor.

#### Sanctuaries and Refuges

The Bodega Marine Life Refuge is located on Bodega Head (see Figure 11-1). The refuge extends 1,000 feet out into the ocean from the mean high tide mark, and includes those parcels of land deeded to the University of California Marine Laboratory. The State Water Resources Control Board (SWRCB) has designated the Bodega Marine Life Refuge an "Area of Special Biological Significance." This designation prohibits the discharge of wastes within the refuge boundaries.

The Point Reyes-Farallon Islands National Marine Sanctuary (PRNMS) encompasses 948 square miles between the mouth of Bodega Harbor, south to Rocky Point (Marin County), and twelve miles west of the Farallon Islands. The sanctuary is administered by the National Oceanic and Atmospheric Administration (NOAA), and was established to protect the recreation, ecological, and aesthetic values of the marine waters within the sanctuary. Waste discharges are prohibited within the sanctuary as defined by the Marine Protection, Research and Sanctuaries Act of 1972. The Farallon Islands themselves are not a part of the marine sanctuary although they occur within the sanctuary boundaries. The Farallon Islands are a Nation Wildlife Refuge administered by the U.S. Fish and Wildlife Service.

At this time the area around Cordell Bank, a submerged seamount located some 20 miles west of Point Reyes, is being considered for inclusion in the National Marine Sanctuaries Program. The exact size of this Sanctuary has not yet been determined, however, one alternative being considered is a large area extending from the northernmost boundary of the PRNMS at the 50-fathom isobar off the Bodega Head, out to the 1,000-fathom isobar northwest of the Bank. Steps yet to be completed in the designation process include preparation of a Draft Management Plan and Environmental Impact Statement (EIS) and preparation of a Final Management Plan and EIS.

### 11.2.3 SAN PABLO BAY

San Pablo Bay has a number of recreational access points along its shores (see Figure 11-2). These facilities provide boat ramps, picnic grounds, fishing piers, and some swimming areas. Public access in these facilities range from limited access to the San Pablo Bay National Wildlife Refuge to open and easy access to the various State and County Parks.

The San Pablo Bay National Wildlife Refuge was established in 1970 to protect 12,000 acres of bay shoreline and open water. Lower Tubbs Island is owned by the U.S. Fish and Wildlife Service, and the remaining thousands of acres of tidelands are leased by the Service from the California State Lands Commission. Uses are limited to wildlife photography and observation, and hunting and fishing. All invertebrate marine life is protected within the refuge. In 1984, approximately 150 pheasant hunters used the Tolay Creek area, and about 100 waterfowl hunters used the open water and mud flat areas on

## FIGURE 11-2

- B** BIRDWATCHING  
**H** MULTI-USE PATH  
**S** SWIMMING  
**F** FISHING  
**P** PICNICKING  
**BF** BALL FIELD  
**BL** BOAT LAUNCH



S. GURGE OCEAN. C. SOCIETY. 1984



the remainder of the refuge. Hikers, birders, photographers and organized groups are permitted to use Lower Tubbs Island.

The California Department of Fish and Game owns or has lease authority over a number of acres of saltmarsh and upland habitat in the North Bay region. The most extensive land holdings by Fish and Game in the San Pablo Bay region include the Petaluma Marsh Wildlife Area (1,800 acres), the Day Island Unit (approximately 2,000 acres, status undesignated), and the Top property wildlife management unit (54 acres). A parcel on Rush Creek (tributary of the Petaluma River) is now owned by a number of public and private groups. This seasonal wetland area of approximately 250 acres, will be managed for wildlife production and is likely to be transferred to the Department of Fish and Game sometime in the future. These parcels and others that DFG has lease rights to, are managed for wildlife production and protection.

The largest and most developed public recreation facilities on the shores of San Pablo Bay are China Camp State Park, John F. McInnis County Park and McNears County Park in the vicinity of Point San Pedro Marin County, and Pt. Pinole Regional Shoreline of the East Bay Regional Parks District. Each of these Parks provide opportunities for picnicking, fishing, hiking, wildlife observation, and a boat launch at McInnis County Park.

In addition to the recreational opportunities along the shores of the Bay, the deep waters and near shore waters of the Bay are popular hunting, fishing, and boating areas (see Figure 11-3). The most recent estimate of user-days for each of these activities and facilities in the north bay region is presented in Table 11-1.

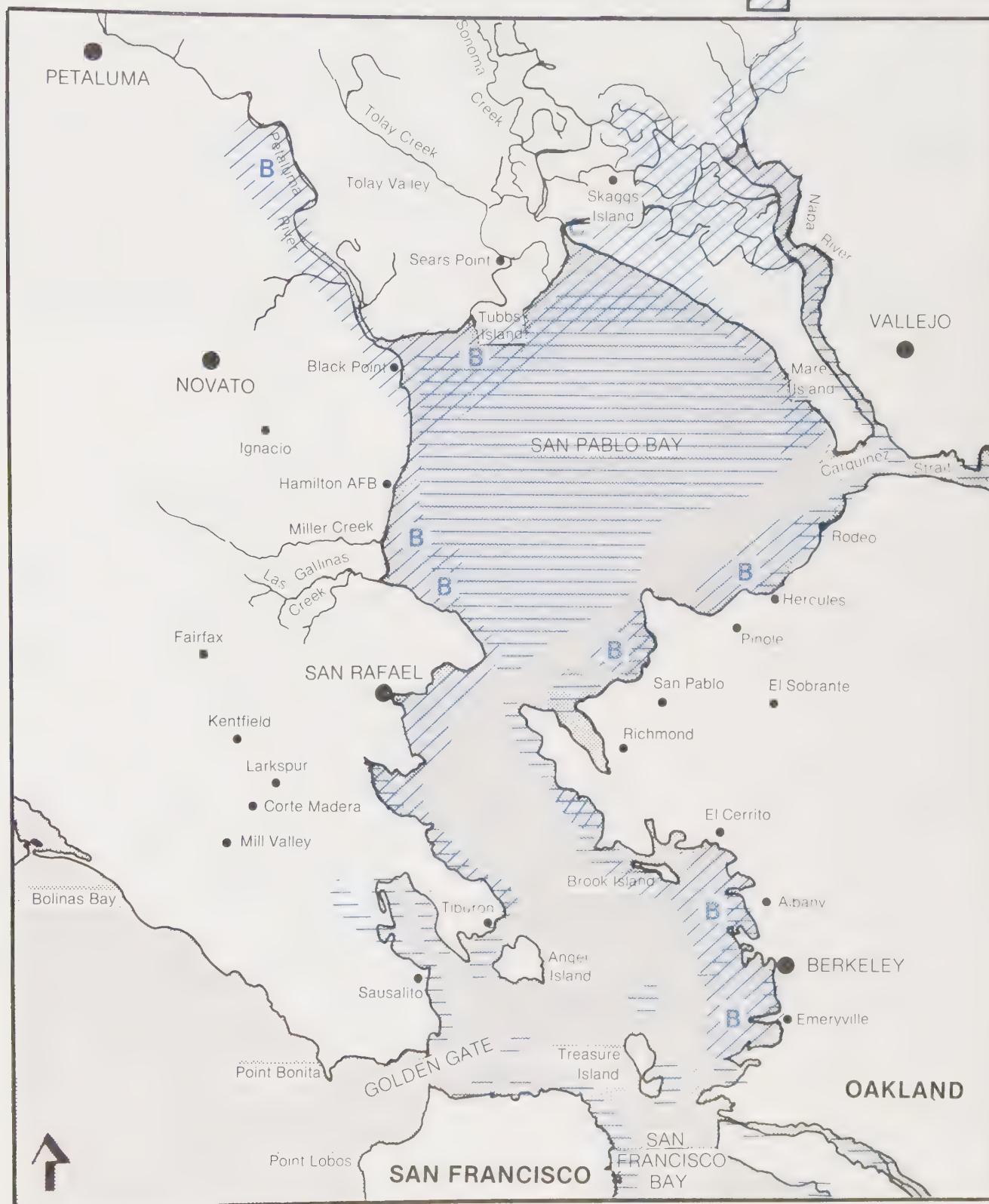
#### 11.2.4 GEYSERS AREA

Recreational opportunities in the Geysers Area are rather limited. The region is dominated by undeveloped natural areas of steep topography covered with native forest and brushlands. The geothermal lease development now dominates the area closing much of the area to public access. Non-consumptive oriented recreational activities such as birdwatching, hiking and sightseeing are probably the most common recreational activities pursued by visitors to this region.

# HUNTING AND FISHING AREAS

FIGURE 11-3

FISHING AREA  BLINDS **B**  
HUNTING AREAS  CLUBS **C**



SOURCE BCDC 1966

eip

TABLE 11-1  
RECREATION USE ESTIMATES

<u>Sites</u>	<u>User-Days</u> <sup>1</sup>	<u>Notes</u>
<u>Non-developed Sites</u> <sup>2</sup>		
Hunting	46,500	This is for the North Bay region exclusive of Suisun Marsh for 1965. Hunter use in 1984 is expected to be somewhat higher. <sup>3</sup>
Non-Consumptive Use (photography, nature studies, etc.)	370,000	This is estimated for 1965 and the entire Bay Area. There are no more recent estimates for San Pablo Bay.
Fishing	2,655,400	"
<u>Developed Sites</u> <sup>4</sup>		
China Camp State Park	1,460,956 day use 14,219 camping	1984 figures. User activities include fishing, hiking, nature viewing, picnicing.
McInnis Park	82,237 total 66,600 ballfield users	1984 figures. This park is partially developed with ballfields, tennis courts and picnic grounds. By the summer of 1986 a large water recreation facility is expected to be completed which would significantly increase user levels; however, the park is not oriented to bay users.
McNears Beach	109,873 total 21,388 pool users	Except for those users of the pool, users would include picnicking, biking, sunbathing, nature viewing and a limited amount of bay swimming. There is no lifeguard at the beach.
Pt. San Pablo Regional Shoreline	87-100,000 total <sup>5</sup> 29-33,000 fishing 29-33,000 picnicking 29-33,000 hiking	The park is open year round, 365 days.

TABLE 11-1 (continued)

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- <sup>1</sup>User-day: a recreationist spending any portion of a day in the park or for a given activity.
- <sup>2</sup>Non-developed sites: Much of the west and northern portions of the San Pablo Bay are open to fishing, hunting and wildlife observation in the marshlands and open waters.
- <sup>3</sup>Prior to 1965 hunter use of the Bay was on a decline; however, user levels are expected to have increased due to the population growth in the region.
- <sup>4</sup>Developed sites: Any County, State or local park with facilities and/or which charges admission.
- <sup>5</sup>Mr. Milt McNeal, East Bay Regional Parks District, phone conversation.
-

There are two designated recreational sites in the Geysers region; the Bureau of Land Management (BLM) owns Pine Mt. Recreation Area located at the end of Pine Flat Road, and a private hunting club exists north of the old Geysers resort.

### **11.3 IMPACTS OF WASTEWATER SYSTEM OPERATION**

#### **11.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS**

##### Impacts

Use of treated effluent to increase or prolong steam production at the Geysers is not expected to affect recreational activities in the area, given the fact that use of the effluent would not substantially change or increase current steam production operations.

##### Mitigation Measures

None are suggested.

#### **11.3.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO THE RUSSIAN RIVER**

##### Impacts

Disposal of treated wastewater to the Russian River could adversely affect recreation, if the abundance and type of fish or the health of swimmers were adversely affected. In neither case, would such an adverse impact be likely as discussed in Chapters 6 and 7. Consequently, no adverse impact on recreation would be expected.

##### Mitigation Measures

None are suggested beyond those listed in Chapters 6 and 7.

#### **11.3.3 ALTERNATIVE 3: DISPOSAL TO THE PACIFIC OCEAN**

##### Impacts

Recreational use of the coast and near shore waters could be adversely affected if ocean disposal of wastewater harmed aquatic life, made shellfish unfit to eat or harmed the health of swimmers or scuba divers. None of the adverse effects would be likely to occur as discussed in Chapters 6 and 7 and thus, the effect of this alternative on recreation would be negligible.

Mitigation Measures

None are suggested beyond those listed in Chapterse 6 and 7.

**11.3.4 ALTERNATIVE 4: DISPOSAL TO SAN PABLO BAY**Impacts

Recreational use of San Pablo Bay and the marshes bordering it could be adversely affected, if disposal of wastewater harmed aquatic life or waterfowl. Neither are likely to be directly and adversely affected by a treated wastewater discharge, although such a discharge in concert with others could contribute to the decline of certain fish species. The issue is discussed at length in Chapter 6. Creation of a freshwater march, which is a part of this alternative, could result in an increase in recreational opportunities if the public can gain access to it.

Mitigation Measures

None are suggested beyond those listed in Chapter 6.

**11.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION**Impacts

Construction of any of the alternatives would temporarily disrupt recreational sites and cause a reduction in recreational uses. Recreation areas are identified in the setting section of this chapter. Temporary adverse effects from construction include noise, dust and degraded water quality. Possible permanent adverse effects from construction would be damage to fish spawning areas from increased silt blanketing gravel substrates.

Mitigation Measures

The following mitigation measures are suggested:

- Mitigation measures outlined in Section 6.4 that would reduce adverse impacts to water quality should be implemented.
- Mitigation measures outlined in Chapter 9 that would reduce siltation in waterways during construction should be implemented.

- o Mitigation measures detailed in Section 14.4.1 that would reduce the noise generated by construction equipment should be implemented.
- o Mitigation measures noted in Chapter 15 that would reduce dust generation should be implemented.

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<sup>1</sup>Sonoma County General Plan. 1977.





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## 12 LAND USE

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### 12.1 INTRODUCTION

This chapter provides a discussion of land uses and land use policies for Sonoma County which would be affected by proposed wastewater treatment and disposal alternatives.

The four proposed wastewater treatment and disposal alternatives are intended to serve the Santa Rosa Subregional Wastewater System within Sonoma County. The cities of Santa Rosa, Cotati, Rohnert Park, Sebastopol and the South Park Sanitation District are included in the System. The South Park Sanitation District lies within Santa Rosa's sphere-of-influence and the lands therein are anticipated to ultimately be annexed into the City.

Three of the alternatives propose disposal of treated wastewater within Sonoma County; a fourth alternative proposes disposal to San Pablo Bay in Marin County. Each alternative relies on the continued use of the Laguna treatment plant on Llano Road, and the continued use of the City of Santa Rosa's wastewater irrigation system.

Proposed pipeline routes would convey treated wastewater throughout the County within eight of nine Sub-County planning areas as shown in Figure 12-1. The proposed pipeline routes would also be within 23 of 37 County specific plan or special study areas and would pass through the Cities of Sebastopol, Rohnert Park, Cotati and Petaluma. This chapter will generally limit discussion of land use policy to those policies within the County's Draft General Plan Land Use Element.<sup>1,2</sup>

Land use within Sonoma County is diverse, ranging from remote mountainous and coastal upland areas, to densely populated cities. The following discussion focuses on land uses around the Laguna treatment plant and along proposed alternative pipeline routes.

## 12.2 SETTING

### 12.2.1 LAGUNA TREATMENT PLANT

The Laguna Treatment Plant is located on Llano Road, in the Santa Rosa and Environs planning area, approximately 8.5 miles from Santa Rosa's City Hall. Sonoma County's Draft General Plan Land Use Map for this area designates the treatment facility as a public facility for the treatment of wastewater. Surrounding land uses include diverse agriculture, grazing and rural residential development. Densities range from 1 dwelling unit per 2 acres in rural residential areas, to 1 dwelling unit per 100 acres in diverse agricultural areas.

The Laguna site is zoned A-1 Primary Agriculture in the South Santa Rosa Specific Plan. Policies of the specific plan which relate to agriculture seek to preserve the rural character of the planning area. Residential development is discouraged in Agriculture areas except where the long term productivity of the resource is assured (Policy 7.20, Agriculture).

Policy 7.21 recommends protecting lands along Llano Road which are included in the Santa Rosa Wastewater Irrigation Program. Several parcels of land which are located near the Laguna plant are included in the program. Wastewater which has received secondary treatment at the Laguna Treatment Plant is pumped through a mainline to irrigate grazing lands, forage crops, hay and silage. All of the alternatives call for continuance of this program at about the present level.

The Sonoma County General Plan (adopted January 1978), supports the reuse of treated effluent and wastewater. Policy 5.4 recommends establishment of a wastewater irrigation program. Policy 5.66 states that: "An adequate water supply from reclaimed, surface, and groundwater sources should be made available in order to meet the needs of agriculture."

The Llano Road corridor is designated as a scenic rural corridor on the South Santa Rosa Specific Plan Open Space Map. Policy 7.52 of the specific plan recommends a 100-foot building setback from the centerline of Llano Road to protect and preserve the scenic quality of the route.

# PLANNING AREAS

FIGURE 12-1



- 1 SONOMA COAST/GUALALA
- 2 CLOVERDALE/N.E. COUNTY
- 3 HEALDSBURG AND ENVIRONS
- 4 RUSSIAN RIVER
- 5 SANTA ROSA AND ENVIRONS
- 6 SEBASTOPOL AND ENVIRONS
- 7 ROHNERT PARK-COTATI AND ENVIRONS
- 8 PETALUMA AND ENVIRONS
- 9 SONOMA VALLEY
- PLANNING AREA BOUNDARY

SOURCE: SONOMA COUNTY DEPARTMENT





### 12.2.2 ALTERNATIVE 1: REUSE AT THE GEYSERS -- WEST AND EAST

This alternative proposes that treated wastewater be pumped from the Laguna plant, via a pipeline, to the Sonoma County geothermal geysers, 40 miles north. Five pumping stations would be located along the pipeline route on land owned by the City of Santa Rosa. The locations of the pumping stations have not yet been determined.

The proposed pipeline would travel north through the Sonoma County planning areas of Santa Rosa & Environs, and Cloverdale/Northeast County. Land uses along the pipeline route, as designated by the Sonoma County Review Draft Land Use Map include: Diverse Agriculture; Rural Residential; Grazing, Forage Crops and Agriculture; Vineyards and Specialty Crops; Low Density Residential; Geothermal and Mineral Resource; and Natural Resource and Conservation.

Densities along the proposed route vary between 1 dwelling unit per acre in low density residential areas at Larkfield, to 1 dwelling unit per 320 acres in the geothermal and mineral resources areas near the geysers.

Objectives of the Draft Land Use Element of the County General Plan indicate a desire to retain those land uses that are currently in Agriculture, Geothermal, and Natural Resource and Conservation designations.

Residential development in the Santa Rosa and Environs area is expected to occur within the sphere of influence boundary of Santa Rosa, and as "in-fill" housing in rural residential areas, outside of this boundary, which have already been designated for such use.

### 12.2.3 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

This alternative proposes that the treatment level of the Laguna Plant be increased, and that treated effluent be discharged to the Russian River via existing ponds and a new rapid infiltration system. The rapid infiltration system would be located on about 100 acres of a site adjacent to the Russian River, and located approximately 14 miles north of the Laguna treatment plant and west of the Town of Windsor.

The proposed site is within the Healdsburg and Environs planning area and is designated Vineyard and Specialty Crop, with a Mineral Resource Conservation Overlay on the Draft General Land Use Plan Map. The Vineyard/Specialty Crop category is intended to preserve and protect lands capable of and generally used for the production of food, fiber and plant materials. The County's Draft Land Use Element allows agricultural production, agricultural processing, visitor-serving uses, minimum residential parcel sizes of 40 acres, and one dwelling unit per 20 - 100 acres. The overlay designation is intended to reserve and protect lands for mineral resource conservation, management, extraction or processing.

Currently agricultural use of the site is primarily vineyards with some orchards and some fallow; gravel extraction has been completed and reclamation plans include filling of the pit with sediment reclaimed from the river, and eventual reclamation to agricultural production.

#### 12.2.4 ALTERNATIVE 3: OCEAN DISPOSAL -- NORTH ROUTE

Alternative 3 proposes that treated wastewater be pumped from the Laguna Treatment Plant via a pipeline to the Pacific Ocean at the west boundary of Sonoma County. One pumping station, located near the treatment plant, would be required to convey the wastewater to the ocean outfall. The pumping station would be sited on land owned by the City of Santa Rosa; however, the specific parcel has not yet been identified.

The pipeline route would follow Sonoma County roads and State Highway 116, to an ocean outfall at Goat Rocks near the town of Jenner. Land uses along the proposed route include Diverse Agriculture; Grazing, Forage and Livestock; Rural Residential; Low Density Residential (within Graton and Forestville); Limited Commercial and Limited Industrial (within Forestville); Geothermal and Mineral Resources; Timberlands; Vineyards and Specialty Crops; Limited Commercial, Recreation/Visitor-Serving Commercial, and Low Density Residential (along the Russian River in Guerneville, Rio Nido and Monte Rio); and Public/Quasi-Public land uses (at the mouth of the Russian River). Densities range from 1 dwelling unit per 160 acres, on Timberlands and Grazing lands, to 1 dwelling unit per acre in Low Density Residential areas.

The Draft Land Use Element of Sonoma County's General Plan recommends the protection and preservation of agricultural lands within the Santa Rosa Plain. In the Russian River Planning Area, residential growth is recommended within existing urban service boundaries only. The commercial center of the Russian River area is directed to remain in Guerneville with secondary commercial centers in Forestville, Rio Nido and Monte Rio. The Sonoma County Plan Draft Land Use Element raises specific concerns relating to enhancement and protection of the Russian River, its tributaries, and redwood groves in timber resource areas. In the Sonoma Coast/Gualala Basin planning area, residential development is recommended to occur within established communities. The plan recognizes the need for protecting resource lands and scenic resources while allowing public access to the coast.

#### 12.2.5 ALTERNATIVE 3: OCEAN DISPOSAL -- SOUTH ROUTE

This alternative proposes the same level of treatment as the North Route option. Treated wastewater would be pumped to the Pacific Ocean from the Laguna Treatment facility. One pumping station would be required near the treatment plant.

The pipeline route would follow Sonoma County roads and State Highway 12 to and through Sebastopol, then following the Bodega Highway, Bay Hill Road and Highway 1 to the mouth of Salmon Creek. Land uses as indicated on Sonoma County's Review Draft Land Use Maps indicate that the pipeline route would encounter a variety of land uses and densities.

Lands uses indicated for the Santa Rosa and Environs planning area are: Diverse Agriculture; Grazing, Forage and Livestock; and Rural Residential. The pipeline route would follow Highway 12 through Sebastopol. Land uses in Sebastopol along the proposed route include Agriculture and Park/Open Space land in the east portion of the city; Downtown Commercial and Park Land in the center of the city; Medium and High Density Residential development with densities of 2 - 15 dwelling units per acre west of the commercial core; and Neighborhood Commercial, Very Low, Medium and High density residential near the city's western boundary.

As the pipeline continues west it would leave Sebastopol and enter the West Sebastopol Specific Planning Area. The West Sebastopol Specific Plan Land Use Map shows land use

designations of Agricultural Residential, Intensive Agriculture, Extensive Agricultural, Open Land Residential, and Resource flanking the proposed route along the Bodega Highway, within the specific planning area. Specific Plan Zoning generally reflects a desire for the protection of agriculture and resource lands through large parcelization and low density. Within the proposed pipeline route, the Exclusive Agriculture and Primary Agriculture zones are predominant. Minimum land parcel size is limited to 5 acres and densities range from 1 dwelling unit per 10 acres to 1 dwelling unit per 100 acres. An envelope of Rural Residential near Freestone allows 5-acre land parcels with 1 dwelling unit per 5 acres.

This alternative is within Sonoma County's Santa Rosa & Environs, Sebastopol, and Sonoma Coast/Gualala Basin sub-county planning areas. Recommendations of the Draft General Plan Land Use Element for these areas focus on the protection and preservation of agriculture and resource lands, accomodation of growth and residential/commercial development in established communities (or in the case of Bodega Bay, land directly contiguous thereto).

#### 12.2.6 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

Alternative 4 proposes that treated wastewater be pumped to the edge of San Pablo Bay in Marin County. The pipeline route would follow Llano Road south from the Laguna Treatment Plant to State Highway 116 to the "hub" of Cotati. The route would then follow the Old Redwood Highway and Ely Road before rejoining State Route 116 and Lakeville Road to State Highway 37. At Black Point, the pipeline would follow the edge of San Pablo Bay, across the marshes, to the mouth of Los Gallinas Creek where an outfall would extend into San Pablo Bay.

The proposed pipeline is within the sub-County planning areas of Santa Rosa & Environs, Sebastopol & Environs, Rohnert Park-Cotati & Environs, and Petaluma & Environs. Land uses along the route include Diverse Agriculture, Rural Residential and Grazing/Forage/-Livestock within the Santa Rosa/Sebastopol & Environs planning areas.

Within the City of Cotati, land uses along the Gravenstein Highway (Highway 116), include Low Density Residential, General Commercial, Freeway Commercial, and Rural Residential. The pipeline route would follow the Old Redwood Highway through the "hub"

of Cotati, where Central Business District, Office and Residential uses radiate from La Plaza Park. City of Cotati zoning applies to the land uses along the Gravenstein and Old Redwood Highways within the City, and includes Agriculture, Commercial, Single-Family Residential and Two-Family Residential. Densities range from 6 dwelling units per acre for Single-Family Residential to 10 dwelling units per acre for Two-Family Residential zones. Land uses south of Cotati (as indicated on the Sonoma County Review Draft Land Use Plans), include Rural Residential with densities of 1 dwelling unit per 1.5, 2, 2.5, and 3 acres. At Penngrove the Old Redwood Highway is surrounded by Low Density Residential, Rural Residential, General Commercial and Limited Industrial land uses. Residential densities in this area are between 1 and 2 dwelling units per acre. From Penngrove to Petaluma, the pipeline route would follow Ely Road. Portions of the proposed route would be within the city of Petaluma near the city's northeast boundary. After leaving residential neighborhoods, the route would again enter agricultural and grazing lands along Highway 116 and Lakeville Road. At Black Point, the pipeline would follow the edge of San Pablo Bay, through marshes, to the mouth of Los Gallinas Creek, where an outfall would extend to the Bay.

### **12.3 IMPACTS OF WASTEWATER SYSTEM OPERATION**

Aspects of the alternatives that would result in permanent or long-term land use changes are described in this section together with the compatibility of the alternatives with zoning and land-use designations.

#### **12.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS -- WEST & EAST**

##### Impacts

This alternative would require 5 pumping stations, several storage ponds and a pipeline 40 miles in length to convey the treated effluent over a 2,000-foot elevation gain. Pumping stations would be located on land owned by the City of Santa Rosa in locations as yet undetermined. One pump station would be located near the treatment plant, a second pump station would be sited in the foothills of the Sonoma Mountains, while the other three pump stations would be spaced evenly from the foothills to the geothermal geysers. Additional storage ponds would be constructed near the City of Santa Rosa or in the Anderson Valley in order to accommodate peak winter time wastewater flows.

This alternative allows the continuation of the Wastewater Irrigation Program on grazing and agricultural lands located on the Santa Rosa Plain. Continuation of the Wastewater Irrigation Program is consistent with the goals and policies of the Sonoma County General Plan, the South Santa Rosa Specific Plan, and the West Santa Rosa Specific Plan, which seek to preserve and protect agricultural uses on the Santa Rosa Plain.

Operation of the proposed pipeline would not impact existing land uses along the route. However, operation of the 5 pump stations could impact sensitive receptors such as schools and hospitals, or could be incompatible with surrounding land uses. Impacts of the pumping stations are difficult to determine at this time, as their locations have not been identified.

### Mitigation Measures

The following mitigation measure is suggested:

- o Pumping stations should be located remote from sensitive receptors and within compatible land-uses.

## 12.3.2 ALTERNATIVE 2: YEAR-ROUND RUSSIAN RIVER DISPOSAL

### Impacts

The use of 100 acres of Vineyard and Specialty Crop land with a Mineral Resource overlay for a rapid infiltration system would be inconsistent with Agricultural and Mineral Resources policies of the Draft Land Use Element of the County's General Plan. Reclamation plans required by the County's Aggregate Resources Plan call for reclamation of the site for agricultural use. Approval of the rapid infiltration system would require a Reclamation Plan Amendment or a change to the reclamation plan and approval by the County Board of Supervisors. Construction of the infiltration system will convert orchards, vineyards or fallow land or land awaiting reclamation to a wastewater disposal site.

One pumping station located near the Laguna treatment facility would be required for the conveyance of treated wastewater to the rapid infiltration field. As the location of this facility is not known the operational impacts on surrounding land uses cannot be gauged at this time.

### Mitigation Measures

The following mitigation measures are suggested:

- o An amendment or changes to the reclamation plans for the rapid infiltration system site should be obtained from the Board of Supervisors prior to approval, construction or operation of the rapid infiltration system.
- o The pumping station should be located within a compatible land use.

#### 12.3.3 ALTERNATIVE 3: OCEAN DISPOSAL - NORTH AND SOUTH

##### Impacts

With this alternative, some of the treated wastewater would continue to be used to irrigate grazing and agricultural lands on the Santa Rosa Plain. Agricultural land would be maintained consistent with the policies of the Draft Land Use and Draft Agricultural Elements of the County's General Plan. This would also be consistent with specific plans which apply to the Santa Rosa Plain.

One pumping station would be required to transport treated effluent to the north or south proposed ocean outfalls. The pumping station would be located near the Laguna treatment facility, however, a specific location has not yet been determined. Land Use impacts associated with the siting of the pumping station cannot be determined until a site location is identified.

### Mitigation Measures

The following mitigation measure is suggested:

- o The pumping station should be located within a compatible land use.

#### 12.3.4 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

##### Impacts

Disposal of treated wastewater into San Pablo Bay would be achieved by pumping the effluent 34-miles via a pipeline, to the mouth of Los Gallinas Creek in Marin County. One pumping station would be required to convey the wastewater to San Pablo Bay. The location of this pumping station has not been identified therefore, land use impacts associated with operation of the pumping station cannot be determined at this time.

As with the other alternatives, some of the treated wastewater would be utilized to irrigate grazing and agriculture lands on the Santa Rosa Plain. This would be consistent with applicable Specific Plans and the Draft Land Use and Agriculture Elements of the County's General Plan.

#### Mitigation Measures

The following mitigation measure is suggested:

- o The pumping station should be located within a compatible land use.

### **12.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION**

This section describes how construction activities might temporarily affect land uses.

#### **12.4.1 ALTERNATIVE 1: REUSE AT THE GEYSERS - WEST AND EAST**

##### Impacts

Expansion of the Laguna treatment plant within existing plant boundaries would not be expected to have a significant effect on surrounding land uses. The effects of construction of ponds and pumping stations would depend on the sites chosen. Construction of the treatment plant would last 18 to 24 months and about six months at the ponds and pumping stations.

Construction of a 40-mile long pipeline from the Laguna plant to the Geysers would create short-term impacts for surrounding land uses. Typically, construction would occur within County road easements and State Highway right-of-ways. Pipelines would be built by a crew of about 20 workers per section; several crews might be working simultaneously along the route. The typical width of the construction corridor would be 25 to 50 feet. Construction would be phased so that a particular pipeline section would be impacted by dust, noise and disruption of traffic for a duration of about four weeks.

Within the Alexander Valley, siting and construction of the pipeline could impact vineyard irrigation and frost prevention pipes which are buried in or near the road right-of-ways.

Land uses that are most sensitive to disruption during construction are "sensitive receptors" such as schools, hospitals and convalescent homes. In Alternative 1b.2, 5 schools were identified along or within 300-feet of the proposed pipeline route. The schools and their locations are as follows: Willowside School -- Willowside Road and Hall; Olivet School -- Willowside Road at Guerneville Road; Piner School -- Piner Road at Fulton; Piner High School -- Fulton Road near Piner Road; and Alexander Valley School -- Alexander Valley Road, southeast of Jintown.

Residential areas along the pipeline route would also be impacted by the noise, dust and traffic disruption associated with construction activity for approximately 4 weeks in any one location.

### Mitigation Measures

The following mitigation measures are suggested:

- o Pipeline construction should be scheduled to minimize conflict with visitor use of Anderson Valley.
- o Pipeline construction should be scheduled to minimize impacts on sensitive receptors. For example, construction near schools should be scheduled to occur during the summer vacation.

## 12.4.2 ALTERNATIVE 2: YEAR-ROUND RUSSIAN RIVER DISPOSAL

### Impacts

Expansion of the Laguna Treatment Plant would minimally impact surrounding land uses, as construction would occur within existing plant boundaries. Construction at the plant would be more extensive for this alternative than for the others.

Pipeline construction could impact one school near the town of Windsor. Starr School is located on Starr Road near Windsor River Road, approximately 200 feet from the proposed pipeline.

Construction of a rapid infiltration system on approximately 100 acres near Windsor could affect adjacent vineyards, orchards and land in fallow.

### Mitigation Measures

The following mitigation measure is suggested:

- o Pipeline construction should be scheduled to minimize impacts on sensitive receptors. For example, construction near Starr School should be scheduled during summer vacation.

#### **12.4.3 ALTERNATIVE 3: OCEAN DISPOSAL -- NORTH ROUTE**

##### Impacts

Construction impacts associated with the expansion of the Laguna treatment plant and construction of the pumping station would minimally disrupt surrounding land uses.

Pipeline construction would generally follow roads except for a 1-1/2 mile section west of Hall Road which crosses the marshlands of the Laguna de Santa Rosa and leads to the town of Graton.

Construction of a pipeline along the north route would impact schools, commercial districts, residences, traffic and recreational uses. The proposed route follows State Route 116 through the towns of Graton, Forestville, Guerneville, Monte Rio and Duncan Mills. Sensitive receptors along the route include two schools in Graton, Oak Grove Union Academy and Pacific Christian School; and the Forestville Union School along State Route 116, in Forestville.

State Route 116 crosses the Russian River via a narrow bridge at the town of Guerneville and enters the town's commercial center. The proposed pipeline would follow S.R. 116 across the river and through Guerneville. Construction would impact traffic along State Route 116, particularly on the bridge, and could potentially impact accessibility to businesses within the S.R. 116 corridor. In addition, noise and air quality impacts associated with construction would affect businesses and homes along the route.

From Guerneville, the route parallels the Russian River to the ocean. This section of the Highway 116 is characterized by steep terrain and a narrow road corridor. Construction of the pipeline would require an area 25 to 50 wide and would result in traffic delays, noise and dust generation. As with the other alternatives, construction of the pipeline would require a crew of approximately 20, working for about 4 weeks in a particular section.

At Goat Rock, an ocean outfall would extend about 11,500 feet offshore. A staging area for construction of the outfall would require about 5 acres along or near the beach. Construction would be completed in 8 to 12 months and would involve a crew of 30 to 50 workers. Goat Rock is a popular recreation area; recreational activity would be disrupted for the duration of construction.

### Mitigation Measures

The following mitigation measures are suggested:

- o Pipeline construction should be scheduled to minimize conflict with visitor use of Guerneville and the Russian River area. Additional information is contained in Chapter 13, Traffic.
- o Pipeline construction should be scheduled to minimize impacts on sensitive receptors. For example, construction near schools should be scheduled to occur during summer vacation.
- o Outfall construction staging area should be chosen to minimize impacts on recreational land use near Goat Rock.
- o Final pipeline routing should be chosen to minimize disruption to business activity in Guerneville.

#### 12.4.4 ALTERNATIVE 3: OCEAN DISPOSAL -- SOUTH ROUTE

##### Impacts

Expansion of the Laguna treatment plant and construction of the pumping station would minimally disrupt surrounding land uses.

From the Laguna Treatment Plant, the route travels north on Llano Road until it reaches S.R. 12 where it turns west toward Sebastopol. The pipeline would be constructed along S.R. 12 through the business/commercial district of Sebastopol. Construction of the route through this area could result in the disruption of business activity due to temporary loss of parking spaces, impeded access, noise and dust. Traffic delays through the business district would be expected during construction, which would take about 4 weeks in a given section.

From Sebastopol to Bodega the proposed route would follow S.R. 12 (Bodega Highway) to Highway 1, which it would follow for about 1 mile before turning onto Bay Hill Road. State Route 12 and Highway 1 carry a large volume of recreational traffic, particularly

in the spring and summer months. Construction activity would require a 25 to 50 foot corridor which could disrupt and impede traffic flow, particularly during the high tourist season.

Bay Hill Road is a narrow, winding road that traverses land currently used for pasture; generally it is a local access road or an alternative to Highway 1. Construction within the Bay Hill Road corridor would preclude the flow of traffic due to the extreme narrowness of the road and would require re-routing of traffic to Highway 1.

Where Bay Hill Road rejoins Highway 1, the pipeline would turn north on Highway 1 to the mouth of Salmon Creek. Highway 1 is heavily travelled and delays or the disruption of traffic flow due to construction would be expected.

An ocean outfall at the mouth of Salmon Creek would extend 8,500 feet offshore. Construction would require a staging area of about 5 acres along or near the beach would take approximately 8 to 12 months to complete. The mouth of Salmon Creek is within the State Beach boundary which is a popular camping and recreation area. Construction activity would disrupt recreation activity within and near the staging area.

Sensitive receptors on or near the route include a hospital, schools and a convalescent hospital. All of the identified sensitive receptors are within or near Sebastopol. Parkside School and Spring Hill School are located along S.R. 12, within 200 feet of the proposed route; Brook Haven School on Valentine Avenue in Sebastopol is within 800 feet of the pipeline corridor. Palm Drive Hospital and Sebastopol Convalescent Hospital are located 1,800 and 2,000 feet respectively from the route, near S.R. 116. These sensitive receptors would be most impacted by noise and dust.

### Mitigation Measures

The following mitigation measures are suggested:

- o Pipeline construction should be scheduled to minimize conflict with visitor use of Sebastopol, the Bodega Highway and Highway 1. Additional information is contained in Chapter 13, Traffic.
- o Pipeline construction should be scheduled to minimize impacts on sensitive receptors.

- o Outfall construction staging area should be chosen to minimize impacts on recreational land use near Salmon Creek.
- o Final pipeline routing should be chosen to minimize disruption of business activities in Sebastopol.

#### 12.4.5 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

##### Impacts

Expansion of the Laguna treatment plant and construction of the pumping station would minimally disrupt surrounding land uses.

From the Laguna Treatment Plant, the pipeline route would follow S.R. 116 (Gravenstein Highway), to and through Cotati. The route would pass through the main business and commercial district in Cotati, including the radial "hub" that serves as the town's focus. Construction impact the central business area causing increased noise, dust, temporary loss of parking and traffic delays along the Gravenstein Highway.

From Cotati, the route follows S.R. 116 to Penngrove, through developing residential areas. From Penngrove, the route continues along S.R. 116 to Ely Road and near the northeastern boundary of Petaluma. South of Petaluma, the route rejoins S.R. 116 and enters agriculture and grazing lands near Lakeville. At Highway 37, the route turns south to Black Point, then leaves Highway 37, travelling through marshland along the edge of San Pablo Bay, to Los Gallinas Creek where an outfall would extend 22,000 feet into the Bay.

Sensitive receptors along or near the route of the proposed alternative include six schools and one hospital. Cotati Elementary School located on School Street in Cotati, is within 1,200 feet of the pipeline route. La Tercera School, on Albin Way in Petaluma, is within 1,300 feet of the route; and Casa Grande High School on Casa Grande in Petaluma is within 2000 feet. Other sensitive receptors include Bernard Eldridge School on Maria Drive (1,500 feet) and the Petaluma Valley Hospital on McDowell Boulevard (2,000 feet), both in Petaluma. The Penngrove School on Adobe Road and Petaluma Hill Road in Penngrove is located within 1,000 feet of the proposed corridor. Southeast of Petaluma, Lakeville School, on S.R. 116 is within 200 feet of the route.

Construction impacts which most affect sensitive receptors include noise and increased dust. Those sensitive receptors closest to the pipeline route would experience the greatest impacts, however, the impacts would be short-term, lasting only about 4 weeks.

### Mitigation Measures

The following mitigation measures are suggested:

- o Pipeline construction should be scheduled to minimize impacts on sensitive receptors.
- o Final pipeline routing should be chosen to minimize disruption of business activities in Cotati.

## **12.5 PERMITS REQUIRED FOR PROJECT CONSTRUCTION**

The proposed wastewater treatment alternatives will require a variety of development permits, encroachment permits, and other approvals before construction and operation of the system is possible. Some of the approvals are granted by local jurisdictions, while others are at a State or Federal level.

All of the alternatives would require the opening or excavation of State Highway Routes for the purpose of placing and concealing pipelines used for the conveyance of treated wastewater. The Department of Transportation (CALTRANS) requires that Encroachment Permits be issued for anything placed in, under, or over any portion of the highway and any driveway or road connected to a state highway. Encroachment permits are also required when vegetation along state highways is tampered with or removed, and for any activity affecting the use of the highway.

Treated wastewater would be discharge directly or indirectly to surface waters in all of the alternatives. The State Water Resources Control Board, Division of Water Quality, requires a National Pollutant Discharge Elimination System (NPDES) permit be obtained. NPDES permits are issued by regional water quality control boards to protect the waters of the state for the use and enjoyment of the people of California.

The Public Utilities Commission requires Certificates of Public Convenience and Necessity for the construction of enlargement of a public utility system, facility, transmission lines, or pipelines.

In addition to those permits, certificates and requirements previously mentioned, some of the alternatives will require additional approvals. Alternative 3, Ocean Disposal, would require a California Coastal Commission, Coastal Development Permit. The coastal zone extends from the State's 3-mile seaward limit to 1,000 yards inland from the mean high tide of the sea. Any development, such as the construction of pipelines and ocean outfalls, proposed within the coastal zone requires a Coastal Development Permit.

Alternative 3 would also be required to obtain a "404" Permit from the United States Army Corp of Engineers. This permit is necessary for any person or public agency proposing to locate structures, excavate, or discharge dredged or fill material into waters of the United States. Outfall pipes are one example of uses requiring this type of permit.

Both the North and South routes of Alternative 3 would require access across state park property near the Pacific Ocean. The State Department of Parks and Recreation requires that any person, public agency, or corporation seeking access across state park lands, obtain a right-of-way from the Department. A right-of-way is a purchased easement similar to one purchased across private property.

Alternative 4, San Pablo Bay Disposal, may require a Development Permit issued by the San Francisco Bay Conservation and Development Commission (BCDC). The BCDC regulated dredging, filling, and land use in an around the San Francisco Bay to protect marshlands, wetlands, and other resources.

Alternative 4 may also require a Dredging Permit from the State Lands Commission, if the dredging of marshes, tidelands, or submerged lands is involved in project construction. This alternative proposes that a portion of the pipeline route be constructed in marshlands along the edge of San Pablo Bay.

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<sup>1</sup> Sonoma County General Plan Draft Land Use Maps, April 16, 1986.

<sup>2</sup> Sonoma County General Plan, Draft Land Use Element, April 11, 1986.



TRAFFIC



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## 13 TRAFFIC

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### 13.1 SETTING

The alternative wastewater management systems could affect traffic flow and safety during construction and operation. Because some of the alternatives involve many miles of pipeline and new facilities remote from the Laguna treatment plant, traffic effects could be felt at a number of widely separated locations.

Existing traffic flows on roads that could be affected by the alternatives are shown in Tables 13-1 through 13-6. Table 13-1 shows traffic volumes on roads near the Laguna treatment plant. Table 13-2 shows traffic volumes on the pipeline route to the Geysers. Similar information for the routes to the rapid infiltration system at the Russian River, the Pacific Ocean and San Pablo Bay are shown in Figures 13-3, 13-4, 13-5 and 13-6.<sup>1</sup>

### 13.2 IMPACTS OF WASTEWATER SYSTEM OPERATION

#### 13.2.1 ALL ALTERNATIVES

##### Impacts

A small number of additional vehicular trips would be generated as a result of operation of the alternative wastewater systems. Alternative 2, indirect disposal to the Russian River includes several new process units at the Laguna treatment plant. Up to 10 new staff would be needed to operate and maintain the process units. Fewer new staff would be needed to run the simpler treatment units included as part of the other alternatives. Up to 20 additional trips each day would be generated by these commuting workers.

Operation and maintenance workers based at the Laguna plant would also periodically visit the pumping stations; probably about once each week. The rapid infiltration system would be visited daily.

TABLE 13-1

## TRAFFIC VOLUMES ON ROADS NEAR LAGUNA TREATMENT PLANT

	<u>Peak Hour</u>	<u>Annual ADT</u>
1. Llano Road; Laguna WTP to Todd Road	150	1,250
2. Llano Road; Todd Road to Highway 12	210	2,200
3. Highway 12; Fulton Road to Sebastopol City Limits	2,250	21,500
4. Todd Road; Llano Road to Stony Point Road	170	1,490
5. Todd Road; Stony Point Road to Highway 101	320	3,140
6. Highway 101; Todd Road Interchange	8,000	69,500
7. Llano Road; Laguna WTP to Highway 116	150	1,100
8. Highway 116; Near Llano Road	1,850	13,000

TABLE 13-2

## TRAFFIC VOLUMES ON ROUTE TO GEYSERS

	<u>Peak Hour</u>	<u>Annual ADT</u>
Llano Road; Laguna WTP to Todd Road	150	1,250
Llano Road; Todd Road to Highway 12	210	2,200
Highway 12 at Llano Road	2,250	21,500
Irwin Lane; Highway 12 to Occidental Road	NA	520
Occidental Road; Irwin Lane to Piezzi Road	410	3,400
Piezzi Road; Occidental Road to Hall Road	NA	NA
Hall Road; Piezzi Road to Willowside Road	NA	1,030
Willowside Road; Hall Road to Guerneville Road	150	1,230
Guerneville Road; Willowside Road to Fulton Road	1,100	10,600
Fulton Road; Guerneville Road to Piner Road	660	6,700
Fulton Road; Piner Road to River Road	850	7,780
Fulton Road; River Road to Airport Boulevard	390	3,660
Fulton Road; Airport Boulevard to Old Redwood Highway	250	1,980
Old Redwood Highway; Fulton Road to East Shiloh Road	470	4,460
East Shiloh Road; Old Redwood Highway to Faught Road	52	344
Faught Road; East Shiloh Road to Chalk Hill Road	45	274
Chalk Hill Road; Faught Road to Highway 128	54	370
Highway 128; Chalk Hill Road to Pine Flat Road	280	1,750
Pine Flat Road; Highway 128 to Red Winery Road	NA	NA
Red Winery Road; Pine Flat Road to Geysers Road	NA	NA
Geysers Road; Red Winery Road to the Geysers	NA	1,010
Geysers Resort Road; east of Geysers Road	NA	800

TABLE 13-3

## TRAFFIC VOLUMES ON ROUTE TO RUSSIAN RIVER

	<u>Peak Hour</u>	<u>Annual ADT</u>
Llano Road; Laguna WTP to Todd Road	150	1,250
Llano Road; Todd Road to Highway 12	210	2,200
Highway 12 at Llano Road	2,250	21,500
Irwin Lane; Highway 12 to Occidental Road	NA	520
Occidental Road; Irwin Lane to Piezzi Road	410	3,400
Piezzi Road; Occidental Road to Hall Road	NA	NA
Hall Road; Piezzi Road to Willowside Road	NA	1,030
Willowside Road; Hall Road to Guerneville Road	150	1,230
Willowside Road; Guerneville Road to Piner	83	600
Piner Road; Willowside Road to Olivet	86	700
Olivet Road; Piner to River Road	130	1,180
River Road; Olivet to Slusser	1,020	10,700
Slusser Road; River Road to Station Road	76	720
Station Road; Slusser to Starr	67	550
Starr Road; Station to Windsor River Road	44	320
Windsor River Road; Starr to Eastside	400	2,250
Eastside Road at Windsor	410	2,250

TABLE 13-4

## TRAFFIC VOLUMES ON NORTHERN ROUTE TO PACIFIC OCEAN

	<u>Peak Hour</u>	<u>Annual ADT</u>
Llano Road; Laguna WTP to Todd Road	150	1,250
Llano Road; Todd Road to Highway 12	210	2,200
Highway 12 at Llano Road	2,250	21,500
Irwin Lane; Highway 12 to Occidental Road	NA	520
Occidental Road; Irwin Lane to Sanford Road	410	3,200
Sanford Road; Occidental Road to Hall Road	74	680
Highway 116 at Frei Road	1,550	9,500
Graton Road; Highway 116 to Hicks Road	NA	920
Hicks Road; Graton Road to Highway 116	NA	300
Highway 116; Hicks Road to Guerneville Road	1,500	7,000
Highway 116; Guerneville Road to Forestville (Mirabel Road)	1,850	9,100
Highway 116; Mirabel Road to Santa Nella Winery Road	700	3,100
Highway 116; Santa Nella to Russian River Bridge	570	2,600
Highway 116; Russian River Bridge to Armstrong Woods Road	800	5,700
Highway 116; Armstrong Woods Road to Guernewood Park (Hulbert Creek Bridge)	1,350	9,700
Highway 116; Hulbert Creek Bridge to Monte Rio Road	1,250	7,600
Highway 116; Monte Rio Road to Austin Creek	980	4,700
Highway 116; Austin Creek to Highway 1	680	3,100
Highway 1; Highway 116 to State Park Road	510	2,000
State Park Road; Highway 1 to end	NA	NA

TABLE 13-5

## TRAFFIC VOLUMES ON SOUTHERN ROUTE TO PACIFIC OCEAN

	<u>Peak Hour</u>	<u>Annual ADT</u>
Llano Road; Laguna WTP to Todd Road	150	1,250
Llano Road; Todd Road to Highway 12	210	2,200
Highway 12; Llano Road to Sebastopol City limits	2,250	21,500
Highway 12; Junction Highway 116	1,750	16,300
Highway 116 at Highway 12	2,600	20,000
Bodega Highway; Highway 116 to Watertrough Road	760	6,640
Bodega Highway; Watertrough Road to Ferguson Road	790	7,870
Bodega Highway; Ferguson Road to Wagnon Road	710	4,850
Bodega Highway; Wagnon Road to Valley Ford	690	4,280
Bodega Highway; Valley Ford to Bodega Lane	610	3,270
Highway 1; Bodega Highway to Bay Hill Road	1,100	4,450
Bay Hill Road; Highway 1 West to Highway 1	NA	NA
Highway 1; Bay Hill Road to mouth of Salmon Creek	1,250	5,000

TABLE 13-6

## TRAFFIC VOLUMES ON SOUTHERN ROUTE TO SAN PABLO BAY

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	<u>Peak Hour</u>	<u>Annual ADT</u>
Llano Road; Laguna WTP to Highway 116	150	1,000
Highway 116 (Gravenstein Highway); Llano Road to Stony Point Road	1,820	13,000
Highway 116; Stony Point to Highway 101	2,280	16,300
Highway 101 at Cotati	7,000	58,000
Old Redwood Highway; Highway 101 to Ely Road	820	8,040
Ely Road; Redwood Highway to Casa Grande	130	1,970
Casa Grande Avenue; Ely to Highway 116	NA	NA
Highway 116; Frates Road to Lakeville Road	1,330	9,600
Lakeville Road; Highway 116 to Highway 37	780	8,050
Highway 37; Lakeville Road to Black Point	2,500	17,600

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The total number of new trips would be too small to affect traffic flows significantly.

### Mitigation Measures

None are suggested

## **13.3 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION**

### **13.3.1 ALL ALTERNATIVES**

#### Impacts

All alternatives would involve construction at the Laguna treatment plant within the existing plant boundaries. Construction work at the site would involve a maximum of 100 workers at any one time, and would continue for about 18 months. Workers would commute to the site and usually work eight-hour days, five days per week. Concrete; reinforcing steel and mechanical and electrical components would be delivered to the site by truck. Concrete would be delivered to the site by ready-mix trucks.

Access to the Laguna treatment plant site would be from Llano Road, either from the north or south. southbound construction traffic would come either from Highway 12 to Llano Road or from Highway 101 south to Todd Road west to Llano Road. Construction traffic from the south would most likely arrive from Llano Road, via Highway 116. Traffic counts for the likely access routes to the Laguna treatment plant are shown in Table 13-1.

Commuting workers would generate about 140 new trips each day, assuming 1.5 workers per car. Truck traffic would be variable depending on level of construction activity, but probably would not exceed 100 trips each day. Because the roads near the treatment plant are lightly travelled, the additional trips would not cause significant traffic congestion. However, the increased truck traffic would be noticeable to road users and might result in some reduction in average vehicle speeds on Todd and Llano Roads.

### Mitigation Measures

The following mitigation measures are suggested:

- o Deliveries of materials to the construction site should be scheduled to avoid peak hours.
- o Off-street parking should be provided for workers cars.
- o Signs should be posted warning drivers on Llano Road of turning truck traffic.

### 13.3.2 ALTERNATIVE 1, REUSE AT THE GEYSERS

#### Impacts

The approximately 40-mile pipeline to the Geysers would follow the route described in Chapter 4 and shown in Figure 4-1. All of the pipeline construction would take place within, or close to, highway rights-of-way. The pipeline would be built in sections by crews of about 20 construction workers. Several crews might work on different sections of the pipeline simultaneously. Workers would commute to the sites daily. Pipe and other materials would be brought to the sites by truck.

Two types of impact would occur; increases in traffic flow as a result of commuting workers and materials trucks, and disruption of traffic flow and parking by construction, itself. The first of these effects would be insignificant as the numbers of trips generated by construction would be very small compared to, highway capacity.

The entire pipeline route to the Geysers would follow lightly-travelled rural roads. One-way traffic operation, controlled by signals or flagmen, would be necessary on the mainly two-lane roads, but traffic disruption would generally be minor. Some traffic delays could occur at the intersection of Highway 12 and Llano Road and the U.S. 101 overcrossing in Fulton.

Both Geysers Road and the partially-paved Pine Flat Road are narrow and steep. Short duration road closures may be necessary to accommodate construction in some sections.

### Mitigation Measures

The following mitigation measures are suggested:

- o All paved surfaces damaged during construction should be repaved when work is complete.
- o Off-street parking should be provided for worker's automobiles or, where this proves impractical, workers should be bussed to the site.
- o The maximum number of highway lanes should be kept open at all times.
- o Flagman or signal-controlled one-way operation should be provided where two-way operation is impractical or unsafe.
- o Temporary steel-plate trench crossings should be provided as needed to maintain access to homes, businesses and farms, etc.
- o Construction sites should be provided with appropriate warning signage and lighting.
- o Construction staging areas should be provided to minimize storage of equipment and material in the traffic lanes.

#### 13.3.3 ALTERNATIVE 2, INDIRECT DISPOSAL TO RUSSIAN RIVER

##### Impacts

The approximately 30-mile pipeline route to the rapid infiltration system would follow the route described in Chapter 4 and shown in Figure 4-1. All of the pipeline construction would take place within, or close to, highway rights-of-way.

The effects of commuting workers and materials trucks on traffic flow would be insignificant. The effects of construction, itself, on traffic flow are described below.

The pipeline to the rapid infiltration system site would follow lightly-travelled rural roads. Most of the roads have only two lanes with narrow or no shoulders. One-way traffic operation, controlled by signals or flagmen, would be necessary in most cases, but traffic disruption would generally minor. Few vehicles would be involved, but they could be subject to considerable delays. The greatest traffic disruption on this route would probably occur at the intersection of Highway 12 and Llano Road.

### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1, Reuse at the Geysers.

#### 13.3.4 ALTERNATIVE 3, DISPOSAL TO PACIFIC OCEAN VIA NORTHERN ROUTE

##### Impacts

The approximately 39-mile pipeline route to the Pacific Ocean via the northern route is described in Chapter 4 and shown in Figure 4-1. All of the pipeline construction would take place within, or close to, highway rights-of-way.

The effects of commuting workers and materials trucks on traffic flow would be insignificant. The effects of construction, itself, on traffic flow are described below.

The pipeline to the ocean would follow State Highway 116 for most of its length. Almost the entire length of the highway has two lanes with shoulders of varying width. Many sections of the highway cross rugged or heavily wooded terrain where highway shoulders are, of necessity, narrow or non-existent. Construction would be expected to be particularly difficult west of Guerneville, where the highway is bordered by rock cuts on the north and the Russian River on the south and surrounded by many mature redwood trees.

One-way traffic operation controlled by signals or flagmen would be necessary on most of the route. Although present peak and average daily traffic flows are far below highway capacity, lengthy traffic delays would likely result particularly during summer weekends when recreational traffic is at its height.

Although the highway broadens through Guerneville, construction would likely displace much of the on-street parking for patrons of businesses. Customer access and deliveries to the businesses would be made more difficult than at present. Access to the many permanent and recreational homes along the route would also be more difficult as would access to recreation areas at Goat Rock.

### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1, with the following additions:

- o Construction work should be carefully scheduled to minimize disruption of traffic flow during summer weekends.
- o Off-street parking should be provided in Guerneville during periods when significant numbers of on-street parking spaces are occupied by construction.
- o Before the pipeline route is finalized all alternatives should be explored that would reduce the identified traffic impacts particularly within Guerneville and Forestville.

### 13.3.5 ALTERNATIVE 3, DISPOSAL TO PACIFIC OCEAN VIA SOUTHERN ROUTE

#### Impacts

The approximately 38-mile pipeline route to the Pacific Ocean via the southern route is described in Chapter 4 and shown in Figure 4-1. All of the pipeline construction would take place within, or close to, highway rights-of-way.

The effects of commuting workers and materials trucks on traffic flow would be insignificant. The effects of construction, itself, on traffic flow are described below.

The pipeline to the ocean would follow Highway 12, the Bodega Highway and Highway 101. Almost the entire length of the highway has two lanes with shoulders of varying width. One-way traffic operation, controlled by signals or flagmen, would be necessary on most of the route. Although present peak and average daily traffic flows are far below highway capacity, lengthy traffic delays would likely result particularly during summer weekends when recreational traffic is at its height. This is particularly true for the segment of Highway 1 between Bodega Bay and Salmon Creek.

Construction of the pipeline through Sebastapol would likely displace much of the on-street parking for patrons of businesses, although it may be possible to maintain two-way traffic flow. Traffic congestion within Sebastapol during peak hours would be made worse by construction activities and customer access and deliveries to businesses would be more difficult than at present.

Access to homes, businesses and farms along the route would be impaired to varying degrees. Because Bay Hill Road is so narrow it is expected that it would be closed to through traffic during pipeline construction. Access for local traffic would be possible but inconvenient.

#### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1, with the following additions:

- o Construction work should be carefully scheduled to minimize disruption of traffic flow during summer weekends.
- o Off-street parking should be provided in Sebastapol during periods when significant numbers of on-street parking spaces are occupied by construction.
- o Before the pipeline route is finalized all alternatives should be explored that would reduce the identified traffic impacts particularly within Sebastapol.

### 13.3.6 ALTERNATIVE DISPOSAL TO SAN PABLO BAY

#### Impacts

The approximately 39-mile pipeline route to San Pablo Bay is described in Chapter 4 and shown in Figure 4-1. About two-thirds of the pipeline construction would take place within highway rights-of-way. The remainder would traverse wetlands bordering San Pablo Bay.

The effects of commuting workers and material trucks on traffic flow would be insignificant. The effects of construction, itself, on traffic flow are described below.

The pipeline to San Pablo Bay would follow Highway 116 or roads paralleling it to Highway 37 before leaving highway rights-of-way. Most of the route follows two-lane highways with shoulders of variable width. One way traffic operation, controlled by flagmen or signals, would be necessary on some segments of the route. In other sections such as Lakeville Road and Highway 37, the highway right-of-way is wide enough to allow speed-restricted two-way traffic flow during construction. Fairly severe traffic congestion and delays could occur on Highway 116 between Llano Road and Highway 101 and on Old Redwood Road in Cotati.

Pipeline construction through Cotati would likely displace some of the on-street parking for patrons of businesses. Customer access and deliveries to businesses would be impaired.

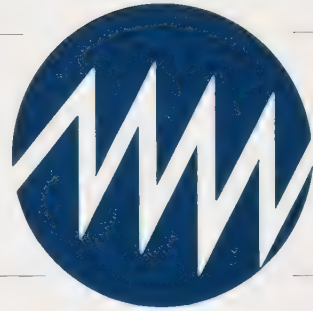
### Mitigation Measures

The same mitigation measures are suggested for this alternative as for Alternative 1 with the following additions:

- o Off-street parking should be provided in Cotati during periods when significant numbers of on-street parking spaces are occupied by construction.
- o Before the pipeline route is finalized, all alternatives should be explored that would reduce the identified traffic impacts particularly within Cotati.

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<sup>1</sup>Information sources include 1984 Traffic Volumes on California State Highways, CALTRANS; Traffic Volumes, Sonoma County 1984, Sonoma County Department of Transportation; and Traffic Volumes, Sonoma County, September 1984 - December 1985, Sonoma County, Department of Transportation.



NOISE



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## 14 NOISE

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### 14.1 INTRODUCTION

The measurement and prediction of noise levels is a complex, technical matter that cannot be explained in a sentence or two. Appendix C discusses in more detail the fundamental concepts of environmental noise. With regard to predicted increases in noise levels, the following information will aid in understanding the numbers used in this report.

- o Environmental noise is usually measured in decibels (dB) or A-weighted decibels (dBA).
- o Noise levels estimated for this report will appear as dBA. The A-weighted scale simulates the response of the human ear to various frequencies of sound.
- o Except in carefully controlled laboratory experiments, a change of only 1 dBA cannot be perceived.
- o Outside the laboratory, a 3-dBA change is considered a just-noticeable difference.
- o A change in noise level of at least 5 dBA would occur before any change in community response would be expected.
- o A 10-dBA change is heard as an approximate doubling of loudness and would almost certainly cause an adverse community response.

### 14.2 SETTING

The project alternatives could affect noise levels near the Laguna treatment plant, near pump stations and along the pipeline routes.

Noise levels are regulated by state and local authorities. The California Department of Health recommends that 60 dBA is the maximum acceptable outdoor noise level for noise-sensitive land uses (residences, schools, churches, hospitals). The California Administrative Code requires that, in areas with greater than 60 dBA noise levels, housing

construction incorporate features to reduce interior levels to 45 dBA in any habitable room. An outside noise that registers at 60 dBA would be reduced to 45 dBA indoors with open windows; with closed windows, noise would be reduced to 35 dBA.

The Sonoma County General Plan discusses the noise levels that currently occur in the vicinity of the treatment plant and throughout the County. The General Plans of the Cities of Santa Rosa, Cotati, Sebastopol and Rohnert Park also discuss noise levels within the urban areas. The primary noise generators in the County include vehicle traffic along highways, railroad operations, the Geysers geothermal power plants, aircraft flyovers and industrial and natural resource extraction activities. Most areas of the cities and County that exceed outdoor noise levels of 60 dBA are located near these sources.

The Draft Noise Element of the Sonoma County General Plan states as its primary goal the "protect(ion) (of) the citizens of Sonoma County from the harmful effects of exposure to excessive noise."<sup>1</sup> To this end, the County has determined that residential and other noise-sensitive land uses are compatible with a maximum outdoor noise level of 60 dBA at night and a maximum daytime noise level of 70 dBA. These policies would apply to nearly the entire wastewater system, as the treatment plant, the outfalls, and most of the pipelines and pump stations would be located on land within Sonoma County's jurisdiction. These policies, however, do not apply to construction noise.

The more than 20 geothermal power plants in the Geysers area generate a significant amount of noise during several phases of operation. The Draft Noise Element of the Sonoma County General Plan notes that the noisiest activities include steam release during well drilling, infrequent steam release from emergency pressure relief valves, and steam venting to clear the lines when returning a shut-down plant to operation. Most of these steam-release activities can be muffled, but noise from emergency releases is uncontrolled. Routine operation of the power plants generates relatively constant noise emissions from cooling tower fans and local truck traffic; this noise is similar to that of other industrial facilities using cooling towers. The Geyser's remote location and the absence of residential development pressure limit potential for land use conflicts due to geothermal power plant operational noise. The County has imposed a maximum noise requirement of 65 dBA Ldn at the boundaries of each leasehold to further reduce the potential for noise conflicts in the vicinity.

### 14.3 IMPACTS OF WASTEWATER SYSTEM OPERATION

#### 14.3.1 ALL ALTERNATIVES

Normal operation of wastewater system alternatives would not have a significant impact on noise levels. Noise emissions from new or expanded process units at the Laguna treatment plant would be similar to those of the existing units. No noise-sensitive uses have been identified in the vicinity of the treatment plant. Although the exact location of the pumping stations is not yet known, the pumps would be enclosed in structures designed to reduce noise to levels that comply with city and county general plans and state standards.<sup>2</sup> Noise emissions from the pipelines themselves would be negligible and would not be heard by pedestrians using the streets in which the pipelines are buried.

#### Mitigation Measures

Because no significant impacts of wastewater treatment or disposal system operation would be expected, no mitigation measures are suggested.

#### 14.3.2 ALTERNATIVE 1: REUSE AT THE GEYSERS

#### Impacts

Noise from geothermal power plant operation would probably change if this alternative is selected. The magnitude and direction of the change, however, is difficult to predict. It is possible that a new power plant would be required to produce steam from the treated wastewater exported from Santa Rosa. At the same time, the additional water injected at the Geysers could prolong the life of existing wells, thereby delaying or alleviating the need to drill new wells. Further study of this issue would be required if this alternative is chosen.

#### Mitigation Measures

- o Geysers operators would be required to adhere to the 65 dBA noise limit at the leasehold boundary, as stated in Sonoma County policies.

### 14.4 IMPACTS OF WASTEWATER SYSTEM CONSTRUCTION

Construction noise would occur at the Laguna treatment plant site, the pumping stations, the outfalls and along the pipeline routes. Construction equipment used at the treatment

plant site would include backhoes, air compressors, welding machines, cranes, ready-mix concrete trucks and delivery trucks. Pile-driving equipment may be used during foundation construction. Construction equipment in use during pipeline construction would include backhoes, dump trucks, loaders, small cranes, water trucks and rollers. Some dynamite blasting may be required along the pipeline routes. Construction activities would continue for 18 to 24 months at the Laguna treatment plant, with a maximum of 100 workers, for 12 to 18 months at the outfall sites with a crew of 30-50 workers and for 6 to 12 months at the pumping station sites. Pipeline construction would occur in sections about 1,000 feet along and 50 feet wide and would last about four weeks at a particular location; 20-member crews would perform this work. Pipeline routes are described in Chapter 4 and shown in Figure 4-1. See Section 4.8 for a more complete description of construction methods.

#### 14.4.1 ALTERNATIVE 4: REUSE AT THE GEYSERS -- EAST AND WEST ROUTES

##### Impacts

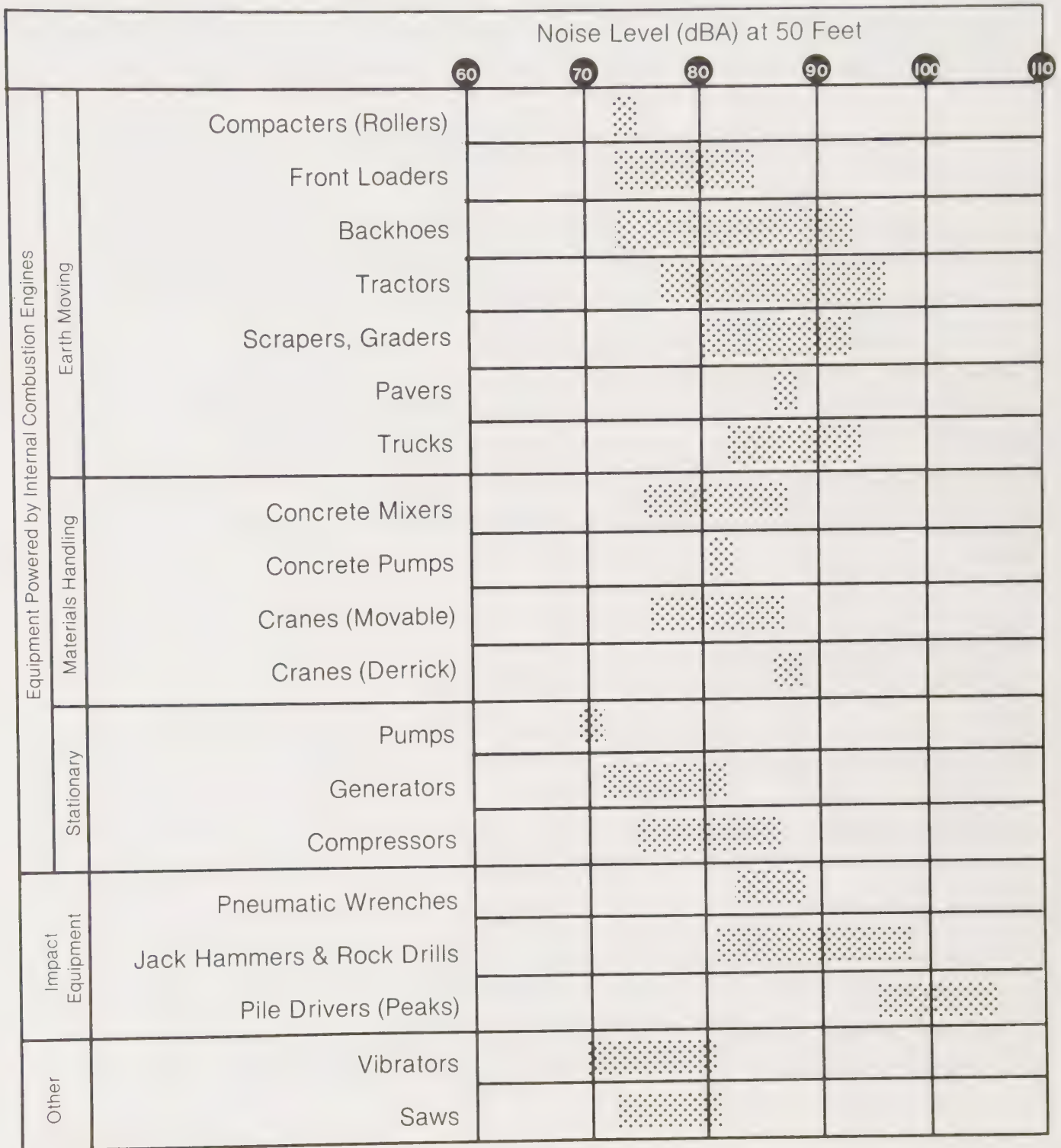
Several noise-sensitive land uses, which include residences, schools, churches and hospitals, are located along the pipeline route for this alternative. In addition to numerous residences, the following list identifies schools and hospitals along the pipeline route and gives approximate distances from the construction work. No noise-sensitive uses have been identified in the vicinity of the Laguna treatment plant.

- o Willowside School, Hall/Piezzi Roads, west of Santa Rosa (200 feet)
- o Olivet School, Willowside Road, west of Santa Rosa (200 feet)
- o Piner School, Fulton Road, west of Santa Rosa (200 feet)
- o Alexander Valley School, Alexander Valley Road, southeast of JIMTOWN (200 feet)

Construction equipment and vehicles would increase temporarily noise levels at the construction sites. Construction machinery typically emits noise of up to 98 dBA at a distance of 50 feet; see Figure 14-1 for noise levels of various types of construction activity and equipment. Construction noise levels would decrease about 6 dBA with each doubling of distance along a clear line-of-sight. That is, noise that registers 98 dBA at 50

# Construction Equipment Noise Range Levels

FIGURE 14-1



**NOTE:** Base on limited available data samples.

feet from construction work would be reduced to 92 dBA and 86 dBA at 100 and 200 feet from the construction, respectively. Exterior noise is reduced by 15 dBA indoors and by an additional 10 dBA indoors with windows closed. It is not likely that construction noise would disturb occupants of buildings more than 1,000 feet from the construction work.

Dynamite blasting may be required at some locations along these pipeline routes, including:

- o Along Chalk Hill Road north of Windsor from Spurgeon Road and south 1.3 miles.
- o Along Geysers Road (west route) or Pine Flat Road (east route) from Red Winery Road to the geysers injection area.

Construction vehicles and equipment and worker commute vehicles would increase noise during travel to and from the the construction sites, but the amount of the increase would not be significant. Construction work would disrupt traffic, increasing noise levels as automobiles idle and accelerate, but this increase would not create a significant adverse effect.

#### Mitigation Measures

The following mitigation measures are suggested:

- o Limit construction work to the hours between 8 a.m. and 5 p.m. to reduce the impact on nearby residences and hospitals
- o Pipeline construction near schools should be scheduled for summer, Christmas or spring breaks when school is not in session
- o All construction equipment should be properly maintained and muffled
- o On-site mechanized construction equipment that generates significant amounts of noise (such as idling diesel engines) should be shut off when not in direct use
- o Where possible, heavy equipment should be located as far as possible from nearby sensitive noise receptors

#### 14.4.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

Impacts associated with this alternative are similar to those identified for Alternative 1. One noise-sensitive land use has been located in the vicinity of construction sites for this alternative:

- o Windsor Middle School, Starr Road, Windsor (200 feet)

The Laguna treatment plant would require expansion under this alternative, as with the other alternatives, but the pipeline from the plant would be much shorter. This disposal method would require construction of infiltration ponds which would involve significant grading and excavation. Windsor Middle School would be located in the vicinity of the holding ponds, but it would probably be about 3,000 feet from the ponds. The pipeline route for this alternative is not yet known, but it is likely that construction would come within several hundred feet of the school.

No dynamite blasting would be required for this project.

#### Mitigation Measures

Mitigation measures proposed for Alternative 1 are also suggested for this alternative.

#### 14.4.3 ALTERNATIVE 3: OCEAN DISPOSAL -- SOUTH ROUTE

##### Impacts

The impacts associated with this alternative are similar to those identified above. Sensitive uses identified along the southern ocean disposal route include:

- o Parkside School, Route 12, Sebastopol (200 feet)
- o Spring Hill School, Route 12, west of Sebastopol (200 feet)
- o Brook Haven School, Valentine Avenue, Sebastopol (800 feet)
- o Palm Drive Hospital, near Route 116, Sebastopol (1,800 feet)
- o Bodega Bay Elementary School, Canon Road, Bodega, (2,500 feet)
- o Sebastopol Convalescent Hospital, Petaluma/Walker Sts., Sebastopol (1,800 feet)

Dynamite blasting may be required at several locations along this pipeline route, including:

- o Along Bodega Highway west of Sebastopol, from Water Trough Road to Ferguson Road.
- o Along Highway 1 between Freestone and Bodega from Watson School (not currently used as a school) to 3,000 feet east of Watson School.
- o Along Highway 1 southwest of Bodega from the Valley Ford Cutoff to Bay Hill Road.
- o Along Bay Hill Road west of Bodega from Highway 1 to 3,000 feet north of Highway 1.
- o Along Bay Hill Road northeast of Bodega Bay from 2,000 feet east of Highway 1 to 5,000 feet east of Highway 1.

#### Mitigation Measures

Mitigation measures suggested for Alternative 1, above, would also be applicable to this alternative.

#### 14.4.4 ALTERNATIVE 3: OCEAN DISPOSAL -- NORTH ROUTE

##### Impacts

The impacts associated with this alternative are similar to those outlined for the previous alternative, except for the location of noise-sensitive land uses. Those located along the northern pipeline route include:

- o Oak Grove Union School, Oak Grove Avenue, Graton (2,000 feet)
- o Pacific Christian Academy, Donald Street, Graton (1,600 feet)
- o Forestville Union School, Route 116, Forestville (200 feet)

Some dynamite blasting may be required along parts of this pipeline alignment, including:

- o Along Guerneville Highway (Route 116) from 1.5 miles west of the edge of Forestville to 1.9 miles west of town.
- o Along Route 116 from 2.3 miles east of the edge of Guerneville to 3.0 miles east of town.
- o Along Route 116 from 1,000 feet west of the edge of Guerneville to 2,500 feet southwest of town.

- o Portions along 116 on the north side of the Russian River from Villa Grande to Bridgehaven, if the pipe is laid along the north side of the road. Blasting would not be required at the crossing at Austin Creek, at the town of Duncan's Mills, and at the crossing at Sawmill Creek.
- o Along Highway 1 west of Jenner from the Goat Rock access to the coast.

### Mitigation Measures

Mitigation measures suggested for Alternative 1 are also suggested for this alternative.

#### 14.4.5 ALTERNATIVE 4: SAN PABLO BAY DISPOSAL

### Impacts

The noise impacts for this alternative would be similar to those identified for previous alternatives. Sensitive receptor locations along this pipeline route include:

- o Cotati Elementary School, School Street, Cotati (1,200 feet)
- o La Tercera Elementary School, Albin Way, Petaluma (1,300 feet)
- o Casa Grande H.S., Ely Road/Casa Grande, Petaluma (200 feet)
- o Bernard Eldridge School, Maria Drive, Petaluma (1,500 feet)
- o Petaluma Valley Hospital, McDowell Boulevard, Petaluma (2,000 feet)
- o Penngrove School, Adobe Road/Petaluma Hill Road, Penngrove (1,000 feet)
- o Lakeville School, Highway 116, southeast of Petaluma (200 feet)
- o Beverly Manor Nursing Home, Monroe St./Maria Dr., Petaluma (2,000 feet)

No dynamite blasting would be required for this alternative.

### Mitigation Measures

Mitigations proposed for Alternative 1 are also suggested for this alternative.

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<sup>1</sup> Noise Element of the Sonoma County General Plan (Draft), Prepared by Brown-Buntin Associates for the Sonoma County Planning Department, October 1, 1986.

<sup>2</sup> Dave Richardson, Project Manager, CH2M-Hill, telephone communication, 28 April 1986.





# AIR QUALITY



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## 15 AIR QUALITY

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### 15.1 SETTING

The setting for all of the wastewater management alternatives except reuse at the Geysers is similar except for sensitive receptor locations, discussed below. The unique air quality considerations of the Geysers area are also discussed below.

#### 15.1.1 CLIMATE

Regional climatic characteristics and geographic location affect climate in Sonoma County. A migrating high pressure area over the northern Pacific Ocean, the Pacific High, determines local weather patterns, including amount of precipitation, cloud cover, direction of prevailing winds and fog conditions. In the wet season, the southern position of the Pacific High causes storms to enter Sonoma County. In the dry season, the northern location of the pressure unit routes storms to the Pacific Northwest.

The general flow of air through the San Francisco Bay area also determines climate in Sonoma County. During the dry season, both the Pacific High's location and the presence of a thermal low pressure area in the interior valleys produce strong, steady winds off the ocean. When combined with the upwelling cold water near the coast, the flow of air through the San Francisco Bay area produces coastal fogs.

During the dry season winds are generally from the northwest and precipitation is uncommon, although occasional measurable precipitation occurs in the mountains to the northeast and northwest. Low clouds and fog develop when prevailing winds transport air over upwelling, cold offshore water. Fog intrusion is most prevalent along the western edge of the County and inland to the valleys; the southern part of the County is subject to deep fog intrusion when cold marine air enters San Pablo Bay and travels inland, pushed by winds from the west. Temperatures in the County vary during the dry season, but cool,

moist air along the coast generally keeps temperatures lower than in the interior valleys, where maximum temperatures may exceed 100°F.

Winds prevail from the south during the wet season, bringing increased cloud cover, higher precipitation and lower temperatures. Precipitation varies throughout the County during the wet season with the heaviest amount recorded in the coastal mountains. There, annual precipitation averages 65-70 inches; the valleys record 30-35 inches per year. The southern County areas near San Pablo Bay receive 20-25 inches of precipitation per year. Fog occurs in the wet season primarily in the valleys and tends to be ground fog rather than the marine fog common in the dry season. Temperatures during the wet season are relatively mild, with occasional lows below 32°F.

Exposure to sea breezes tempers the climate of Santa Rosa and nearby cities; this area is otherwise typical of interior valleys. Summer maximum daily average temperatures are in the mid-80s F with minimum average temperatures in the 50s F. Winter temperatures range from an average maximum of 55°F to a low of 35°F. Annual rainfall averages 29 inches and occurs primarily between November and April. Sunshine is plentiful, although low clouds are frequent in the evening, night and morning during the spring and summer. Southerly winds are prevalent at Santa Rosa, reflecting the channeling effect of the Petaluma Valley to the south and the hills to the east. Southwest and west winds are the second most frequent winds in the area, reflecting the location of the Estero Lowlands.

#### 15.1.2 AMBIENT AIR POLLUTANT CONCENTRATIONS

The Clean Air Act of 1967, as amended, established air quality standards for several pollutants. The Act outlines primary standards designed to safeguard human health and secondary standards intended to protect the public welfare from adverse effects such as visibility reduction, soiling, nuisance and other forms of damage. In addition, the State of California has adopted its own standards. The federal and state standards listed in Appendix D provide acceptable durations for pollutant levels designed to avoid adverse effects within a margin of safety.

The Bay Area Air Quality Management District (BAAQMD) monitors air quality in the San Francisco Bay Area by operating a network of monitoring stations. Table 15-1 presents pollutant measurements recorded for the past five years at the Santa Rosa monitoring

TABLE 15-1  
SANTA ROSA AIR POLLUTANT SUMMARY, 1982-1985

<u>Pollutant</u>	<u>Federal Standard</u>	<u>State Standard</u>	<u>Monitoring Data</u>			
			<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
<u>Carbon Monoxide (CO)</u>	9.0	9.0				
Highest 8-hour average (ppm)			5.8	4.6	4.9	5.9
No. of exceedances			0	0	0	0
<u>Ozone (O<sub>3</sub>)</u>	.124	.10				
Highest 1-hour average (ppm)			0.09	0.12	0.09	0.09
No. of exceedances of federal standard			0	0	0	0
<u>Nitrogen Dioxide (NO<sub>2</sub>)</u>	None	.25				
Highest 1-hour average (ppm)			0.09	0.11	0.12	0.16
No. of exceedances of state standard			0	0	0	0
<u>Sulphur Dioxide (SO<sub>2</sub>)</u>	.14	.05				
Highest 24-hour average (ppm)			<0.001	0.003	0.003	0.005
No. of exceedances of state standard			0	0	0	0
<u>Total Suspended Particulate (TSP)</u>	150	100				
Annual Geometric Mean (ug/m <sup>3</sup> )			36	31	37 <sup>1</sup>	40 <sup>1</sup>
No. of exceedances of state standard			0	0	0	0

<sup>1</sup>Refers to violations of the federal standard.

Source: BAAQMD, Air Currents, San Francisco, March issues: 1983, 1983, 1983 and 1986.

station; the data indicates that the air quality in Santa Rosa complies with applicable state and federal standards.<sup>1</sup>

The ozone data collected at this monitoring station is likely to be representative of conditions throughout southern Sonoma County because of the widespread nature of ozone air pollution. In contrast, elevated concentrations of particulates (TSP) and carbon monoxide (CO) tend to be more localized phenomena, with concentrations decreasing rapidly with increasing distance from the source. Motor vehicles are a primary source of CO, hydrocarbons (HC) and nitrogen oxides (NOx); the latter two pollutants are major components of photochemical reactions that form ozone. Santa Rosa is the most heavily urbanized area of Sonoma County; therefore, it is likely that concentrations of vehicle-generated pollutants elsewhere in Sonoma County would be lower than concentrations recorded in Santa Rosa. Agricultural activities such as ploughing and crop-dusting are a significant source of particulates, so it is possible that pollutant levels could exceed TSP standards elsewhere in the County.

As a result of violations of air quality standards in the San Francisco Bay region, the Association of Bay Area Governments (ABAG), the BAAQMD and the Metropolitan Transportation Commission (MTC) jointly prepared the 1979 Bay Area Air Quality Maintenance Plan as part of the Environmental Management Plan.<sup>2</sup> The 1979 Plan contains strategies for long-term attainment and maintenance of air quality standards, including measures to reduce emissions from automobiles and stationary sources, and the Plan suggests transportation control measures to reduce automobile use. Air quality problems addressed in the 1979 Plan are excesses of photochemical oxidants (principally ozone), CO and TSP. In 1982 ABAG updated the Plan to ensure compliance with ozone and CO standards by 1987.<sup>3</sup> A key CO reduction strategy discussed in the 1982 Plan is inspection and maintenance (I&M) of motor vehicles; the State of California adopted a mandatory I&M program in 1984 that is expected to reduce CO by 16% in the Bay Area.

### 15.1.3 SENSITIVE RECEPTORS

Several "sensitive receptors," or people who are most susceptible to adverse health impacts from air pollution, are located along the pipeline routes. The BAAQMD defines sensitive receptors as children, the elderly, and acutely or chronically ill people; the land uses where these population groups are most commonly found include residences, schools

and hospitals.<sup>4</sup> No sensitive receptors have been identified in the vicinity of the treatment plant. The following list locates schools and hospitals along the pipeline routes, showing distances from the construction work. In addition, many homes are scattered along the pipeline routes that are not identified here.

Alternative 1: Reuse at the Geysers -- East and West Routes

- o Willowside School, Hall/Piezzi Roads, west of Santa Rosa (200 feet)
- o Olivet School, Willowside Road, west of Santa Rosa (200 feet) Piner School, Fulton Road, west of Santa Rosa (200 feet)
- o Alexander Valley School, Alexander Valley Road, southeast of Jintown (200 feet)

Alternative 2: Year-Round Russian River Disposal

- o Windsor Middle School, Starr Road, Windsor (200 feet)

Alternative 3: Ocean Disposal -- Northern Route

- o Oak Grove Union School, Oak Grove Avenue, Graton (2,000 feet)
- o Pacific Christian Academy, Donald Street, Graton (1,600 feet)
- o Forestville Union School, Route 116, Forestville (200 feet)

Alternative 3: Ocean Disposal -- Southern Route

- o Parkside School, Route 12, Sebastopol (200 feet)
- o Spring Hill School, Route 12, west of Sebastopol (200 feet)
- o Brook Haven School, Valentine Avenue, Sebastopol (800 feet)
- o Palm Drive Hospital, near Route 116, Sebastopol (1,800 feet)
- o Bodega Bay Elementary School, Canon Road, Bodega (2,500 feet)
- o Sebastopol Convalescent Hospital, Petaluma/Walker Sts., Sebastopol (1,800 feet)

Alternative 4: San Pablo Bay Disposal

- o Cotati Elementary School, School Street, Cotati (1,200 feet)
- o Latcera Elementary School, Albin Way, Petaluma (1,300 feet)
- o Casa Grande H.S., Ely Road/Casa Grande, Petaluma (200 feet)
- o Bernard Eldridge School, Maria Drive, Petaluma (1,500 feet)
- o Petaluma Valley Hospital, McDowell Boulevard, Petaluma (2,000 feet)
- o Penngrove School, Adobe Road/Petaluma Hill Road, Penngrove (1,000 feet)
- o Lakeville School, Highway 116, southeast of Petaluma (200 feet)
- o Beverly Manor Nursing Home, Monroe St./Maria Dr., Petaluma (2,000 feet)

#### 15.1.4 ODORS

There are some odors associated with the Laguna treatment plant's current operation. In 1982 and 1983, the BAAQMD recorded 50 and 23 complaints, respectively, regarding odors from the treatment plant.<sup>5</sup> Those same years, the Laguna treatment plant received 50-75 complaints per month in late summer months about the odors from sludge stored at the treatment plant.<sup>6</sup> It appears that the number of complaints increases in the summer primarily because people keep their windows open, not because the heat significantly changes the sludge odor. Some complaints are about intermittent, rather than pervasive odors, such as when septic tank pumper trucks discharge wastes at the treatment plant. In 1984, the number of complaints dropped off when a substantial portion of the sludge was relocated to a remote storage site. Also, the facility stopped using an unreliable aerobic digester in 1982, when it caused a number of complaints. In 1985, the City of Santa Rosa installed a belt-press dewatering system and now transports the sludge to a landfill site located seven miles from the treatment plant, halfway between Santa Rosa and Petaluma. The plant superintendant expects that odor complaints will decrease even further as a result of the new system.<sup>7</sup>

Some odors are associated with "plant upset", which can occur when an unexpected chemical not normally present in sewage is discharged into the wastewater system and kills the organisms that prevent putrefaction. No plant upsets have occurred at the Laguna plant for the past five years.<sup>8</sup>

Some methods of reducing odors are available to the City; currently, one of the treatment units has an air scrubber system that uses potassium permanganate filters to clean air exhaust from the unit before it is released to the atmosphere. Plant operators also use a deodorizing system that sprays perfume into the air near the plant.

#### 15.1.5 AIR QUALITY AT THE GEYSERS

As is the case in most other remote, rural areas in California, air quality in the Geysers area is generally good. Monitoring of common air pollutants (i.e., carbon monoxide, sulfur dioxide, non-methane hydrocarbons, and particulates) at the Geysers has shown that the ambient concentrations typically encountered are appreciably below State and Federal standards. This is because these pollutants are largely caused by human activities. Total

emissions are small in the Geysers when compared to urban areas, because of the much lower population density.

There are air quality problems at the Geysers, but they differ from those found elsewhere. Water contained in subterranean rock formations is heated and vaporized by hot molten rock, which lies relatively close to the earth's surface. A small amount of this geothermal steam/hot water finds its way to the surface in naturally occurring fumaroles and hot springs, but a much larger amount is extracted as steam and used to generate electrical power. This steam/fluid contains a small amount of dissolved gases and solids (about 1% or 2% by weight), which are either of volcanic origin or were leached out of the reservoir matrix over the years during which the steam/hot water has been confined.

The noncondensable gases present in steam from wells in the Geysers are, in percent-by-weight order: carbon dioxide, hydrogen sulfide, methane, ammonia, nitrogen, hydrogen, and methane. The steam also contains traces of dissolved solids, such as boron, arsenic, mercury, and other inorganic elements (also in percent-by-weight order), and small amounts of the radioactive element radon. Table 15-2 shows the high, low and average concentrations of these substances in steam sampled throughout the Geysers.

Hydrogen sulfide is the only gas that causes an environmental problem in the area. Even so,  $H_2S$  is not emitted in sufficient quantities to cause death or injury to human, animal, or plant life, but is enough to create an intermittent nuisance sulfur odor. The other gases are either of low toxicity (e.g., carbon dioxide) or are emitted in quantities too small to cause air quality problems (e.g., ammonia and methane). The dissolved solids contained in the steam can also be released into the air when steam is vented into the atmosphere or when steam condensate droplets are released from power plant cooling towers. Of the dissolved solids mentioned above, only boron is emitted in quantities large enough to cause environmental problems. Damage to vegetation has been observed in the vicinity of power plant cooling towers and has been associated with boron emission.

TABLE 15-2

## NONCONDENSABLE GASES AND SOLIDS IN STEAM FROM WELLS AT THE GEYSERS

	Concentrations, ppmw <sup>1</sup>		
	Average	High	Low
Carbon Dioxide	3,260	30,600	290
Hydrogen Sulfide	222	1,600	5
Methane	194	1,447	13
Ammonia	194	1,060	9.4
Nitrogen	52	638	6
Hydrogen	56	218	11
Methane	N/A	19	3
Boron	16	39	2.1
Arsenic	0.019	0.050	0.002
Mercury	0.005	0.018	0.00031
Radon <sup>2,3</sup>	39.5	39.5	39.5

<sup>1</sup>Parts per million by weight.

<sup>2</sup>Based on an analysis of the steam sampled from three production wells located on or near the Wildhorse A-1 leasehold.

<sup>3</sup>Radon concentrations are given in nanocuries per pound of steam.

Sources: Coldwater Creek Geothermal Power Plant Application for Certification, Central California Power Agency, Tables 1.4-2 and 1.4-3, pp. 1-12 and 1-13, April 1984.

Comprehensive Air Monitoring Plan Reports, California Energy Commission, Tables 3-1 and 3-2, p. 31, February 1980.

Environmental Impact Report for Wildhorse A-1 Leasehold Field Development, p. 49.

## 15.2 IMPACTS OF WASTEWATER SYSTEM OPERATION

### 15.2.1 ALL ALTERNATIVES

The project's operational impacts on air quality would occur regardless of choice of alternative. However, wastewater disposal at the geysers presents additional air quality considerations; these are discussed further in the following section.

#### Impacts

Project-generated vehicle trips for maintenance and operation of the treatment plant and disposal system would contribute a minor amount of CO and other vehicular emissions to the regional air pollution burden. However, this impact is too small to measure and would be insignificant.

It is unlikely that odors associated with sludge handling and wastewater treatment would increase with a change in the volume of wastewater. Studies are proceeding on alternate sludge disposal methods for the 1990s, when the City expects to implement some form of beneficial reuse.

#### Mitigation Measures

Because no significant impacts of system operation would be expected, no mitigation measures are suggested.

### 15.2.2 ALTERNATIVE 1: REUSE AT THE GEYSERS

#### Impacts

Air quality at the Geysers could be affected if the injected wastewater altered the chemical quality of the steam emitted from existing cooling towers. The chemical quality of the treated wastewater is different from that of the naturally occurring geothermal fluid, and thus some change is possible. The wastewater effluent would contain higher levels of organic and suspended matter than geothermal fluid. It would contain lower levels of certain inorganic substances, such as boron, arsenic and mercury, than the geothermal fluid, and higher but still very low levels of lead and cadmium.

It is impossible to know with certainty what would be the ultimate fate of substances injected into the ground in the wastewater. It seems likely that at least some of the substances would remain in the ground rather than emerge with the steam. Even if they did not, the concentrations of metals in the wastewater are too low to harm vegetation as demonstrated by the on-going pasture irrigation program. Thus, wastewater injection would not be expected to make worse the present adverse effects of geothermal steam on native vegetation attributed to boron fallout.

#### Mitigation Measures

None are suggested.

### **15.3 IMPACTS OF PROJECT CONSTRUCTION**

#### **15.3.1 ALL ALTERNATIVES**

##### Impacts

The type of construction impacts would be similar for all alternatives, but impacts will differ in degree of severity because of sensitive receptor locations (identified in Section 15.1). Construction impacts would occur at the Laguna treatment plant, the pumping stations, the outfalls and along the pipeline routes. Construction activities would continue for 18-24 months at the Laguna treatment plant with a maximum crew of 100 workers. Construction would occur for 12-18 months at the outfalls with crews of 30-50 workers, and for 6-12 months at the pump stations. Pipeline construction would occur in 1,000-foot segments with 20-member crews; construction would last about 4 weeks on each segment. Pipeline routes are discussed in Chapter 4 of this report and shown in Figure 4.1. Section 4.8 contains a more complete description of construction activity.

Construction activities would create a temporary increase in dustfall and therefore an increase in TSP concentrations near construction sites. Equipment and vehicles generate particulate matter (dust) during clearing, excavation and grading. Construction vehicle traffic on unpaved access roads also increases dust. Wind movement over exposed earth surfaces produces "fugitive" dust or wind-blown dirt. In addition, traffic along the pipeline routes would resuspend dust on the roadways.

State and federal 24-hour average particulate standards could be violated in the vicinity of construction sites. It is not possible to estimate accurately the particulate concentrations that would occur at or adjacent to the construction sites because of the complexity of local meteorology and topography and variations in soil silt and moisture content. However, measurements taken during apartment and shopping center construction in the southwestern United States provide a rough estimate of construction impacts on local particulate emissions; these figures indicate that approximately 1.2 tons of dust are emitted per acre per month of construction activity.<sup>9</sup>

During construction, increased dust may aggravate respiratory ailments and cause eye irritation, and exposed surfaces in the areas surrounding the project site would soil more quickly than usual. Although it is not possible to estimate how far from the site the elevated particulate levels would exist, it is likely that occupants of residences, schools and hospitals within 1,000 feet of the construction would notice the dust. Sensitive receptors near the pipeline routes were identified in the setting section of this chapter. No sensitive receptors are located in the vicinity of the treatment plant.

Construction vehicles and equipment and worker commute vehicles would emit exhaust at the construction sites, which would contribute to local and regional pollutant concentrations, but the amount of the increase would not be significant and would not cause violations of any air quality standards.

### Mitigation Measures

The following mitigation measures are suggested:

- o Dust emissions related to construction can be reduced approximately 50% by watering exposed earth surfaces during excavation, grading and construction activities. All construction contracts should require watering in late morning and at the end of the day; frequency of watering should increase if wind speeds exceed 15 mph. Conditions of approval should also require daily cleanup of mud and dust carried onto street surfaces by construction vehicles.
- o Throughout excavation activity, haul trucks should use tarpaulins or other effective covers.
- o Upon completion of pipeline construction, contractors should take measures to reduce erosion. These measures include replanting, spreading soil binders and repeated soaking as need to maintain a crusty surface. Repaving should be completed as soon as possible.

- o Vehicles and machinery should be turned off when not in direct use in order to reduce tailpipe emissions from construction equipment.
- o Pipeline construction for areas near schools should be scheduled to occur during the summer months when school is in recess.

The choice of alternative can be considered a project mitigation in terms of air quality impacts. For instance, although the Russian River alternative involves significant amounts of grading and excavation for construction of the rapid infiltration system, these activities would not occur within 3,000 feet of sensitive receptors. Only one sensitive receptor would be exposed to impacts due to pipeline construction with this alternative. All the other alternatives, with much longer pipeline routes, would expose many more occupants of residences, schools and hospitals to increased dust emissions.

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<sup>1</sup> Air Currents, Bay Area Air Quality Management District, San Francisco, March issues, 1983-1986.

<sup>2</sup> 1979 Bay Area Air Quality Maintenance Plan, Association of Bay Area Governments, Bay Area Air Quality Management District, and Metropolitan Transportation Commission, Berkeley, 1979.

<sup>3</sup> 1982 Bay Area Air Quality Maintenance Plan, Association of Bay Area Governments, Bay Area Air Quality Management District, and Metropolitan Transportation Commission, Berkeley, 1982.

<sup>4</sup> Air Quality and Urban Development: Guidelines for Assessing Impacts of Projects and Plans, Bay Area Air Quality Management District, San Francisco, November 1985.

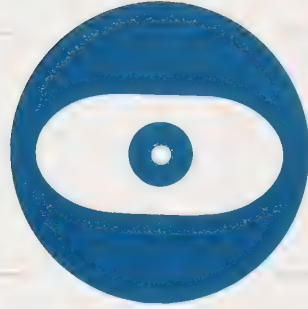
<sup>5</sup> Dan Belik, Inspector, Bay Area Air Quality Management District, telephone communication, May 8, 1986.

<sup>6</sup> Scott Steinbaugh, Superintendant, Laguna Treatment Plant, telephone communication, May 8, 1986.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

<sup>9</sup> Compilation of Air Pollutant Emission Factors, U.S. Environmental Protection Agency, AP-42, Third Edition, October 1980.



# VISUAL QUALITY



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## 16 VISUAL RESOURCES

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### 16.1 INTRODUCTION

This chapter addresses the visual impacts associated with each of the four wastewater treatment alternatives. Issues include expansion of the Laguna Treatment Plant on Llano Road; construction of pipeline routes, pumping stations, Pacific Ocean and San Pablo Bay outfalls; and construction of a rapid infiltration system near the town of Windsor.

### 16.2 SETTING<sup>1</sup>

Sonoma County is visually diverse and is characterized by a rugged coastline, mountains, rolling hills, and rich agricultural plains and valleys. Twelve regions or "Landscape Units" have been identified by the County's Planning Department based on common natural features or processes as shown in Figure 16-1). The proposed project includes alternative pipeline routes which are within nine of the twelve landscape units.

A photographic survey was conducted for the proposed pipeline routes. Figure 16-2 shows the location and direction of site photos for this section of the report.

#### Coastal Margin

The Coastal Margin is the County's most scenic area and roughly parallels the San Andreas Fault Zone. It is extremely rugged and is marked by vertical sea cliffs and sea stacks. Coastal uplands, headlands and terraces are also dominant landforms. Both north and south ocean disposal routes (3) would terminate within the Coastal Margin with outfalls which would extend into the Pacific Ocean. Figures 16-3A and 3B show the character of the coast at Goat Rocks and Salmon Creek where the north and south outfalls (respectively) would be located. At both locations the coastline is marked by terraces which join rugged and rolling hills to the east.

### Mendocino Highlands

This landscape unit is the largest in area, and is characterized by ridges and mountainous terrain. Logging, open space, agriculture, resort areas, and rural residential uses are characteristic. The northern section is best known for agriculture and timber harvest, with low population and little access. The southern section is much more accessible and populated and has several small unincorporated communities. Within the Russian River area, recreational and scenic resources are most prevalent.

Both the north and south ocean disposal pipeline routes would convey treated wastewater within the Mendocino Highlands landscape unit. The north route would follow the Russian River along narrow winding roads beneath dense tree cover. Figure 16-4A shows the Guerneville Bridge (on the pipeline route) which crosses the Russian River at Guerneville. The south route would be within this Landscape Unit on Bay Hill Road, an extremely narrow road which travels through the rolling hills east of the coastal margin (Figure 16-4B shows the character of the road and landscape).

### Alexander Valley

This is a narrow valley within the Russian River floodplain. The dominant land use is agriculture in the form of orchards and vineyards; along the flood plain land uses include gravel extraction, milling, residential development, and river recreation. Residential settlements are defined by the floodplain and are confined to the settlements of Cloverdale and Geyserville.

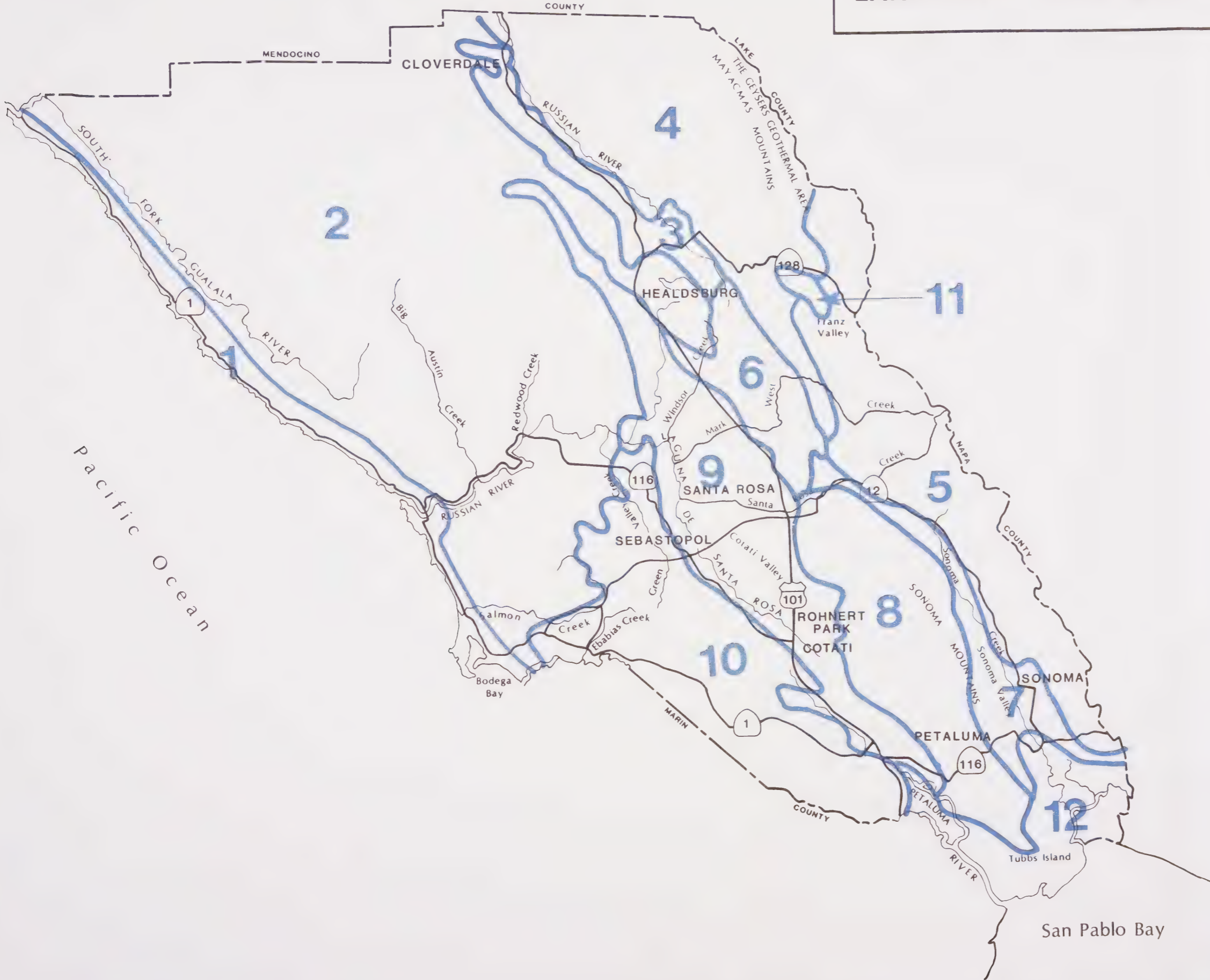
A short section of the proposed Geysers pipeline is within the south portion of the the Alexander Valley near Jintown. The valley is primarily used for grape production in this area.

### Mayacamas Mountains

This landscape unit forms the eastern boundary for Alexander Valley and the northwest and northeast boundary for Knights Valley. Mining and logging were important land uses in the past, however, more recently, the area has been recognized for its geothermal geysers which generate electric power.

# LANDSCAPE UNITS MAP

FIGURE 16-1



- 1 COASTAL MARGIN
- 2 MENDOCINO HIGHLANDS
- 3 ALEXANDER VALLEY
- 4 MAYACMAS MOUNTAINS
- 5 SONOMA-NAPA MOUNTAINS
- 6 MARK WEST SPRINGS
- 7 VALLEY OF THE MOON
- 8 SONOMA MOUNTAINS
- 9 SANTA ROSA-PETALUMA VALLEY
- 10 MERCED HILLS
- 11 KNIGHTS VALLEY
- 12 BAYFRONT MARSHES

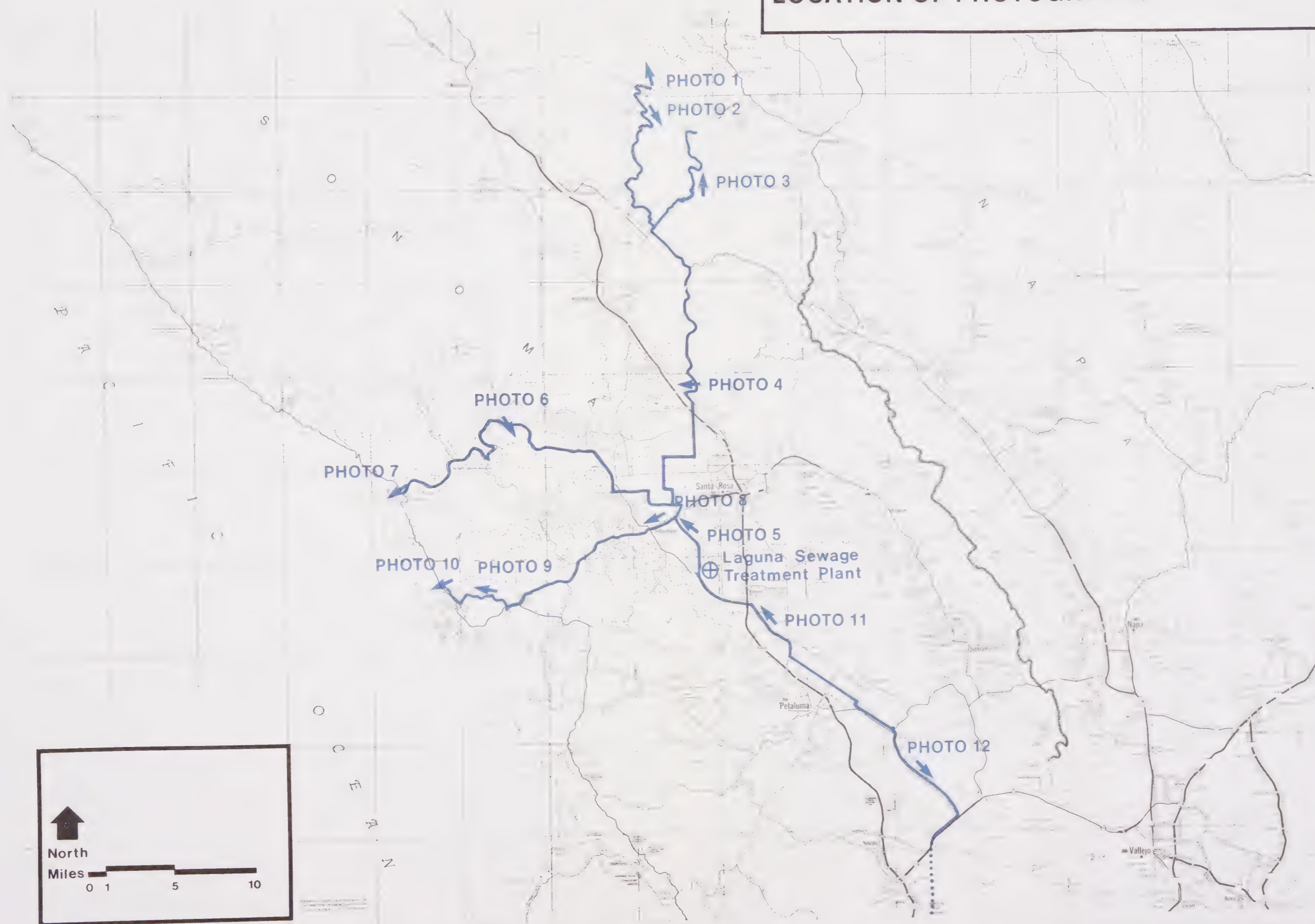
SOURCE: SONOMA COUNTY PLANNING DEPARTMENT





# LOCATION OF PHOTOGRAPHS

FIGURE 16-2



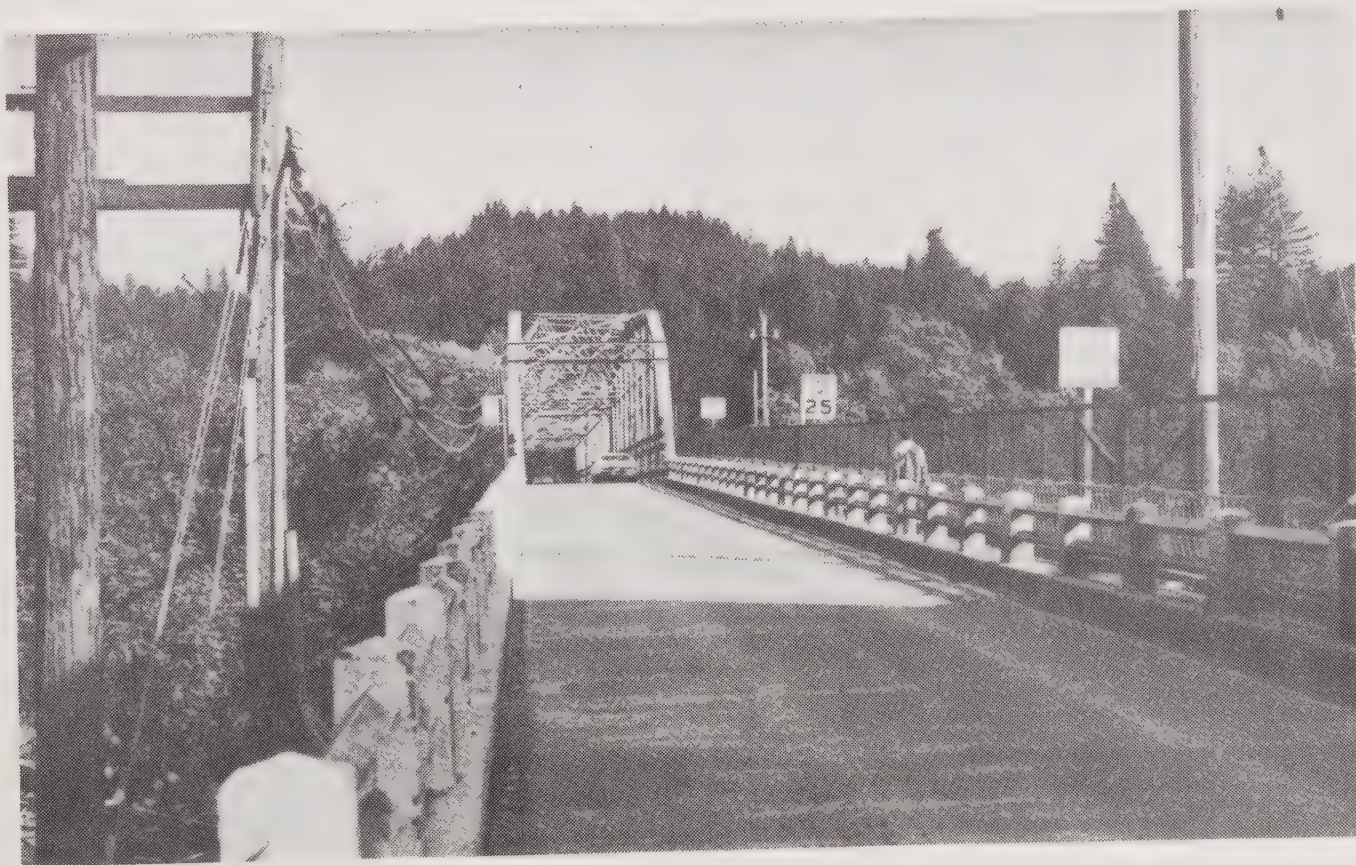




**A.** Location of Ocean Outfall at Goat Rocks



**B.** Location of Ocean Outfall at Salmon Creek



**A.** Highway 116 Bridge at Guerneville



**B.** Looking West on Bay Hill Road

The Geysers pipeline routes, Pine Flat Road and Geysers Road (Figures 16-5A and 5B) would both terminate within this landscape unit. The terrain is best described as rugged hills or rolling mountains. Figure 16-6A shows the character of the Geysers geothermal area.

### Sonoma-Napa Mountains

This landscape unit creates the southern half of the County's eastern boundary. These mountains are more rugged and less luxuriantly vegetated than the Mayacmas Mountains. Agriculture and recreation are the primary land uses in the Sonoma-Napa Landscape Unit.

None of the proposed alternatives have been proposed within this landscape unit.

### Mark West Springs

This is an area of active faulting associated with the Healdsburg Fault. Mark West Springs is located north of the City of Santa Rosa and is characterized by agricultural land uses which include grazing, vineyards and orchards.

A section of the Geysers alternative would be located within this landscape unit on land used for grazing, vineyards and rural residential development. Figure 16-6B shows the character of the area.

### Valley of the Moon

This is a long narrow valley bordered on east by a range of mountains with sharp jagged peaks, and on the west by the Sonoma Mountains. Several unincorporated communities are located within the valley, with urban concentrations located at the cities of Sonoma and Rincon Valley. The Valley is known for its orchards and vineyards, as well as its preservation of historic cultural resources.

None of the proposed alternatives would be located within this landscape unit.

### Sonoma Mountains

These mountains form a continuous background of rolling hills along the southeastern border of the Santa Rosa Plain-Petaluma Valley from San Pablo Bay to Santa Rosa. Major land uses include grazing, dairying, vineyards, recreation and residential uses.



**A.** Pine Flat Road



**B.** Geysers Road



**A.** Geysers Geothermal Area



**B.** Looking West on Pleasant Ave From Chaulk Hill Road

A small section of the San Pablo Bay disposal alternative near Petaluma is located within this landscape unit. Residential and flat grazing land is typical of the proposed pipeline section within the Sonoma Mountains landscape unit.

#### Santa Rosa-Petaluma Valley

This unit is also known as the Santa Rosa Plain is a plain surrounded by a rim of hills. The Santa Rosa Plain is the commercial and residential heart of Sonoma County, with settlement occurring in the communities of Healdsburg, Santa Rosa, Rohnert Park, East Cotati and East Petaluma.

All of the wastewater treatment alternatives are included within the Santa Rosa-Petaluma Valley as the Llano Treatment Plant is located on the Santa Rosa Plain. In addition, the proposed site for the Russian River alternative's rapid infiltration system is located within this landscape unit near Windsor. Figure 16-7A shows the character of the Valley on Llano Road near S.R. 12 and Figure 16-7B shows a section of the route through the Cotati business district.

#### Merced Hills

This landscape unit consists of hills and valleys. The hills to the north are steep while in the south they are more rounded, due to weathering. This area is economically important due to agricultural practices which include apple orchards in the north, and dairies and poultry activity in the south. The cities of Sebastopol, west Cotati and west Petaluma are within this area as well as the communities of Forestville, Graton, Hessel-Cunningham, Bodega, Freestone, Bloomfield and Valley Road.

Portions of the ocean disposal alternatives are within this landscape unit. The north pipeline route would reach from Sebastopol to Forestville, while the south alternative would go through Sebastopol to Freestone and Bodega. The north route is characterized by suburban development near Sebastopol, and agriculture and rural residential development near Forestville. The south route goes through the commercial center of Sebastopol (see Figure 16-8A). After leaving Sebastopol the route enters rural agricultural lands.



**A.** Looking North on Llano Road (at Highway 12)



**B.** Looking North on Old Redwood Highway at Cotati



**A.** Sebastopol Business District From Highway 12



**B.** Looking South on Lakeville Road

### Knights Valley

This is the smallest of the twelve landscape units and is virtually absorbed by the Mayacmas Mountains. The most striking visual element of this area is Mount Saint Helena which rises to an elevation of 4262-feet. The primary land use is agriculture and includes dairys, orchards and vineyards.

None of the proposed alternatives is located within the Knights Valley landscape unit.

### Bay Front Marshes

This landscape unit is located at the extreme southern tip of the County. This area is very flat with elevations ranging from -3 feet below sea level to 40 feet above. The Petaluma River, Tolay Creek, Schell Creek, Sonoma Creek and their tributaries and associated sloughs combine to fragment the land area in the Bay Front Marshes unit. Land uses are limited by a high water table and severe septic tank limitations. Much of the area is in forage crops and salt marshes.

The San Pablo Bay alternative terminates in Marin County, close to the boundaries of this landscape unit. A section of the pipeline, along Lakeville Road and Highway 37 is also within this region. Figure 16-8B shows the character of the area along Lakeville Road.

## **16.3 IMPACTS OF THE WASTEWATER SYSTEM OPERATION**

The proposed project alternatives propose expansion of the treatment plant, construction of new off-site holding ponds, pumping stations, transmission pipelines, and rapid infiltration system. In addition, all of the alternatives would retain the wastewater irrigation program, and would produce increased amounts of sludge, which would have to be disposed of in landfills.

### **16.3.1 ALTERNATIVE 1: REUSE AT THE GEYSERS**

#### Impacts

Expansion of the treatment plant would occur within existing plant boundaries and would consist of additional buildings, tanks and mechanical equipment generally similar to those already on the site. The expansion could result in the treatment plant being slightly more prominent in the landscape than it is currently.

This alternative would require five pumping stations to transport treated wastewater to the Geysers Geothermal area. The five pumping stations would consist of pumps housed in small concrete block structures, about 30 feet square and 20 feet high. They would be similar in appearance to buildings located at the treatment facility. The location of the pump stations has not as yet been determined, however, one would be located near the treatment plant, another in the foothills of the Mayacmas Mountains and the others spaced evenly to the Geysers. Although the pump stations would be fenced, they may conflict with existing character and land uses of the foothills and Mayacmas Mountains.

Pipeline construction would occur within road right-of-ways and the pipeline would be buried beneath the ground. Visual impacts associated with construction would generally be short-term in nature. However, the likelihood of vegetation removal for pipeline installation exists.

#### Mitigation Measures

The following mitigation measures are suggested:

- o A landscape plan should be developed and landscaping installed which adequately screens new construction at the treatment plant with plantings which are compatible with existing landscaping and native vegetation of the adjacent area.
- o Pumping stations should be sited well below ridgelines and should be painted to blend in with their surroundings in the Mayacmas Mountains area. Naturalistic plantings should also be used to provide appropriate screening.
- o Once the pipeline route has been determined precisely, a study should be conducted which identifies trees of special significance and cathedral groves along the routes. In these areas, the trees should be protected and pipeline construction should be confined to the roadway.

### 16.2.2 ALTERNATIVE 2: INDIRECT DISPOSAL TO RUSSIAN RIVER

#### Impacts

Expansion of the treatment plant would take place within existing plant boundaries, and would include additional buildings, mechanical equipment and holding ponds. Plant expansion could visually impact the character of the landscape by increasing the visual prominence of the plant.

A rapid infiltration system would be constructed on approximately 120 acres of land adjacent to the Russian River. A potential site has been identified near the town of Windsor, about 14 miles north of the treatment plant. The proposed site is currently used for agriculture; portions of the site are also being reclaimed from gravel extraction to agriculture. Visual impacts of the project would include grading, removal of site vegetation, and earthen basins replacing agricultural land.

This alternative would require one pumping station which would be constructed near the treatment plant. The pumping station would be constructed of concrete block and would be about 20 feet in height and 30 by 30 feet square. A site for the pumping station has not yet been identified, therefore specific visual impacts cannot be determined; however the building could be visually prominent depending upon surface finish and siting within the landscape.

Pipeline construction would occur within road corridors and the pipeline would be placed below-grade. In the event that the pipeline is constructed within the road right-of-way near the shoulder, vegetation could be removed.

### Mitigation Measures

The following mitigation measures are suggested:

- o A landscape plan should be prepared and landscaping installed which screens the treatment plant from adjacent land uses and public roads. Vegetation should be selected which is compatible with existing landscaping and indigenous plants.
- o A grading plan should be developed which results in sensitive siting of the holding and rapid infiltration ponds. Denuded slopes should be revegetated.
- o The rapid infiltration field should be screened from adjacent land uses and public roads by naturalistic plantings.
- o The pumping station should be sited well below ridgelines and painted with finish colors which allow the structure to blend into the landscape. Landscaping should be employed to screen the pumping station.
- o Vegetation removed during pipeline construction should be restored or replaced. A study should be conducted which identifies significant trees or cathedral groves along the route; construction of the pipeline should be accomplished in the road bed where possible to protect trees identified as significant.

### 16.3.3 ALTERNATIVE 3: OCEAN DISPOSAL -- NORTH & SOUTH

#### Impacts

The two Ocean disposal routes propose expansion of the Laguna Treatment Plant within plant boundaries. As with the other alternatives, expansion could visually impact the surrounding landscape.

One pumping station would be required for these alternatives; the location is not currently known, however, the pumping station could visually conflict with surrounding land uses.

Pipeline construction could result in the removal of vegetation, particularly along the Russian River on the heavily wooded north route.

Ocean outfalls could be visually apparent at the County's Coastal Margin, thus impacting the pristine natural quality of the area.

#### Mitigation Measures

The following mitigation measures are suggested:

- o Plant expansion should be screened with suitable vegetation to blend in with existing buildings and equipment and retain the existing character of the site in the landscape.
- o The pumping station should be sited well below ridgelines and painted to be compatible with existing development. The station should also be screened with suitable ornamental plantings and native vegetation.
- o Vegetation that is removed for construction of the pipeline should be restored or replaced. Significant specimen trees or groves of trees should not be disturbed or destroyed by construction of the pipeline. A study should identify areas of significant vegetation and the pipeline construction should be confined to the roadbed in these areas.

### 16.3.4 ALTERNATIVE 4: DISPOSAL TO SAN PABLO BAY

#### Impacts

The Laguna Treatment Plant would be expanded within existing plant boundaries. Expansion would include the construction of additional buildings, holding ponds, and mechanical equipment. As described in other alternatives the visual impacts of plant expansion could result in increased incompatibility with surrounding land uses.

One pumping station would be constructed near the Laguna plant. A location for the pumping station has not been identified, therefore it is difficult to determine specific visual impacts at this time. Siting and finish colors of the structure will determine its compatibility with the surrounding landscape.

Pipeline construction would take place in existing road beds except from Black Point to the mouth of Los Gallinas Creek, where the pipeline would follow the edge of San Pablo Bay in marshland. Marsh vegetation and biotic habitat would be damaged or destroyed during pipeline construction.

Vegetation along the pipeline route might be damaged or removed during construction, thus changing the character of the area.

### Mitigation

The following mitigation measures are suggested:

- o A landscape plan should be developed and landscaping installed which adequately screens the Laguna Treatment Plant from surrounding land uses and public roads. Plant materials should be selected which are compatible with existing landscaping and indigenous vegetation.
- o The pumping station should be sited well below ridgelines and finished with paint which allows the structure to blend in with its surroundings. Landscaping should be employed to screen the structure from surrounding land uses.
- o Marshlands and vegetation damaged or removed during pipeline construction should be replaced or restored on an acre-for-acre basis. Alternate pipeline routes should be considered which do not impact marshlands.
- o A vegetation study should be done which identifies significant trees and cathedral groves along the pipeline route. Significant trees and tree groves should not be removed or damaged by pipeline construction. Where possible, the pipeline route should be located within the roadbed to avoid damage to significant vegetation.

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<sup>1</sup> Much of this discussion is taken from Sonoma County General Plan Bulletin: Landscape Units Map Index, published in October 1974 by the Sonoma County Planning Department.





# SOCIOECONOMICS



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## 17 SOCIOECONOMICS

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### 17.1 SETTING

The socioeconomic characteristics of the study area are the same regardless of the method of treated wastewater disposal. Therefore, this section of the chapter does not differentiate among the alternatives, treating them as if they are all the same project.

#### POPULATION AND INCOME

The Santa Rosa wastewater treatment plant and disposal system serves the cities of Cotati, Rohnert Park and Sebastopol in addition to Santa Rosa and parts of the unincorporated area of the County. In general, the spheres of influence of these cities encompass the unincorporated County areas served by the Santa Rosa wastewater system. Table 17-1 shows the population growth of these areas from 1970 through the present. As shown in the table, the service area population has grown 47% in the past 10 years. The most rapid growth occurred between 1975 and 1980; Rohnert Park's population nearly doubled during that period.

In 1980, median household income for the cities in the service area ranged from \$20,417 in Cotati to \$23,608 in Santa Rosa. The Sonoma County 1980 median household income was \$23,631, which was significantly higher than the statewide median of \$18,243. The highest median incomes in the County are found in some rural areas; in rural Santa Rosa and rural Petaluma, average household incomes exceed \$27,000. The percentage of families in the study area with incomes below the poverty level in 1980 ranged from 6.5% in Santa Rosa and Sebastopol to 8.8% in Rohnert Park and 11.3% in Cotati. By comparison, 7.1% and 8.7% of the families in the County and the State, respectively, have incomes below the poverty level.

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TABLE 17-1  
STUDY AREA POPULATION  
1975-1985

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1985 Portion of Total</u>	<u>% Increase 1975-1985</u>
Cotati	3,511	4,233	4,950	3%	41%
Rohnert Park	13,134	24,541	28,900	18%	120%
Santa Rosa	87,551	109,150	120,400	74%	38%
Sebastopol	<u>6,204</u>	<u>7,411</u>	<u>7,800</u>	<u>5%</u>	<u>26%</u>
Total Study Area	110,400	145,335	162,050	100%	47%

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Sources: Association of Bay Area Governments, Projections '79 and Projections' 85.  
EIP Associates.

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## EMPLOYMENT

The County's strongest employment sectors are manufacturing, retail trade and services; in 1980, these three sectors constituted 64% of the total county employment. In general, employment distribution by sector in the cities in the study area is similar to that of the County (see Figure 17-1). This would be expected because 70% of the County's population resides in urban areas and half the urban population resides in Santa Rosa.

Some differences between the County and city employment bases are expected, however. For instance, the cities are less dependent on agriculture than the County overall, with agriculture and mining providing only 2% to 3%, rather than the County's 5%, of total jobs. Sebastopol is a notable exception; agricultural employment provides 12% of the total in this area. Some other differences exist between the County's pattern of industry and those of the various cities. In Cotati, for example, retail employment provides more than 30% of total jobs, compared to 21% in the County overall. Service sector employment in Sebastopol and Rohnert Park ranges from 30% to 35% of the total, compared to 25% in the County overall. In 1980, Rohnert Park had a lower than average amount of manufacturing and wholesale employment but this sector grew significantly over the next five years and, in 1985, was a few percentage points higher than the County average. Santa Rosa's employment base is quite similar to the County average, except for the fact that "other" employment, which includes government jobs, is about 32% of the total, compared to the County average of 26%. A majority of County government offices are located in Santa Rosa, as well as the City's workers and school district and junior college employees.

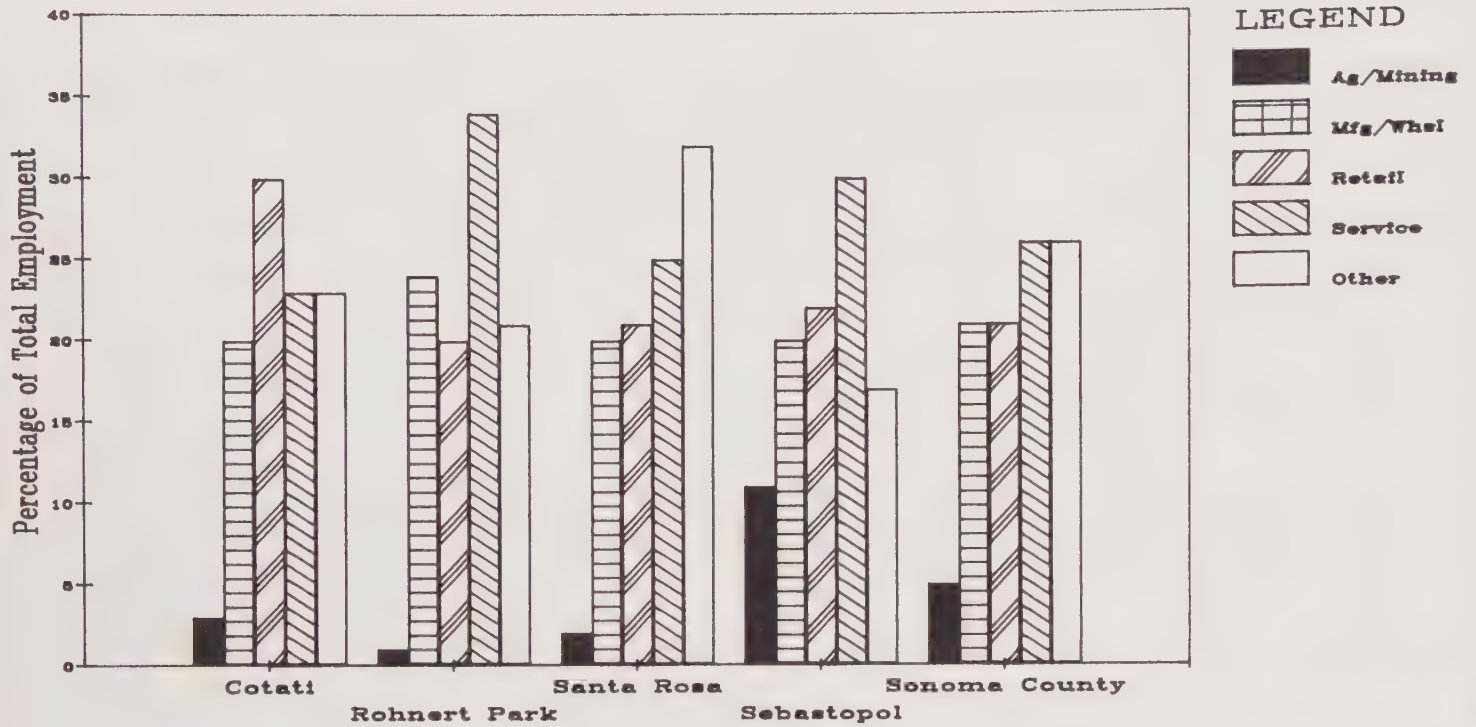
Santa Rosa is clearly the dominant employment center in the study area (Figure 17-2). The City has nearly 85% of the total jobs in the area, but only 73% of the population. Comparing employment and employed resident figures for each city demonstrates that Rohnert Park and Cotati are largely residential communities, but Sebastopol has a ratio of employees that is nearly 1:1 (Table 17-2).

## POPULATION AND EMPLOYMENT GROWTH POTENTIAL

The Association of Bay Area Governments (ABAG) projects employment and population growth for all the cities and counties of the San Francisco Bay region. The projections depend upon assumptions about birth and death rates, land availability and zoning, the

FIGURE 17-1

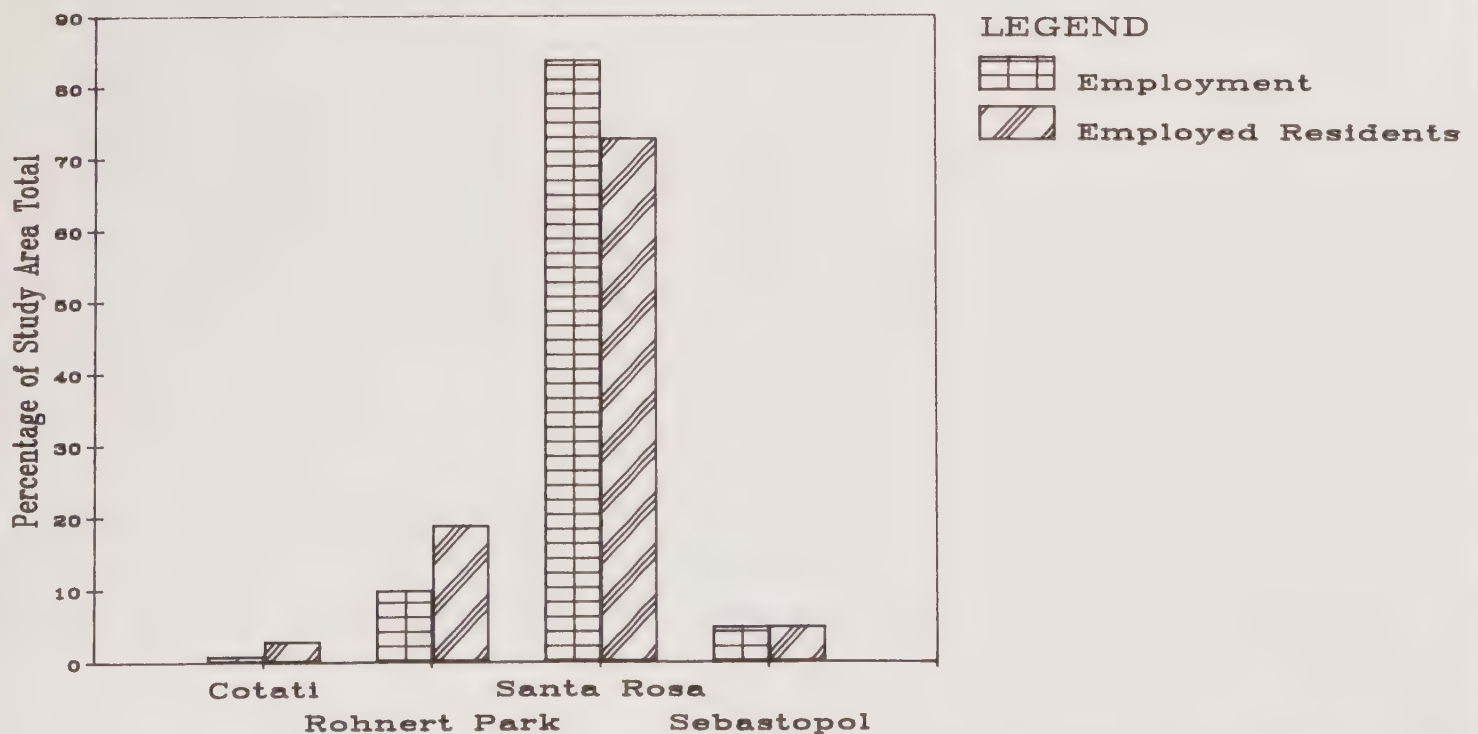
## EMPLOYMENT BY SECTOR 1985



Source: ABAG, Projections '85

FIGURE 17-2

## STUDY AREA EMPLOYMENT 1985



Source: ABAG, Projections '85

TABLE 17-2  
STUDY AREA EMPLOYMENT  
1975-1985

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1985 % of Total</u>
Cotati				
Employment	674	859	1,000	1
Employed Residents	N/A	1,848	2,300	3
Ratio of Employment to Employed Residents	-	1:.46	1:.43	
Rohnert Park				
Employment	2,265	5,280	7,300	10
Employed Residents	N/A	11,129	14,100	19
Ratio of Employment to Employed Residents	-	1:.47	1:.52	
Santa Rosa				
Employment	34,654	55,926	63,300	84
Employed Residents	N/A	47,565	55,100	73
Ratio of Employment to Employed Residents	-	1:1.18	1:1.15	
Sebastopol				
Employment	2,257	3,220	3,400	5
Employed Residents	N/A	3,189	3,500	5
Ratio of Employment to Employed Residents	-	1:1.01	1:.97	
Total Study Area				
Employment	39,850	65,285	75,000	100
Employed Residents	N/A	63,731	75,000	100
Ratio of Employment to Employed Residents	-	1:1.02	1:1	

Sources: Association of Bay Area Governments, Projections '79 and Projections '85.  
EIP Associates.

strength of various economic sectors, and in- and out-migration. The County of Sonoma has also included draft population projections for individual cities and rural areas in the current update of the Land Use Element (now in draft form) of the County's General Plan. The ABAG and the Sonoma County population projections are fairly consistent with each other, varying by only 0.2%-2.4% for the study area as a whole (Table 17-3). Some differences surface when comparing projections for individual jurisdictions because the two projection methodologies use different geographic boundaries.

Sonoma County projects growth by city and surrounding rural area. As noted earlier, ABAG incorporates a city's sphere of influence population into projections for the city's growth. The people that reside outside the urban boundaries but within a city's sphere of influence would be reflected in Sonoma County projections as part of the rural area, rather than in the city category, as shown by ABAG. As would be expected, Sonoma County's predictions of rural populations are higher than ABAG's and the County's estimates of city populations are somewhat lower than ABAG's. When rural and city projections for each city's region are summed, however, the County and ABAG projections are very close, especially considering the 20-year time frame.

Population growth is projected to be fairly steady throughout the service area, with annual increases ranging from 1.4% in Sebastopol to 3.2% in Rohnert Park (Table 17-4). Santa Rosa and Cotati would experience 2.0% and 1.8% annual growth rates, respectively.

Over the next ten years the fastest job growth in the study area would occur in Cotati and Rohnert Park with 3.2% annual increases in employment. Employment growth is projected to slow somewhat after 1995. Job growth will occur at a more modest 1.7% and 2.7% per year in Sebastopol and Santa Rosa, respectively. Santa Rosa's annual employment increase will level off somewhat after 1995, but Sebastopol job growth is projected to continue at a steady pace.

### Agricultural Economics

Treated effluent from the Santa Rosa sewage disposal system currently irrigates about 4,000 acres of cropland for the production of dairy cattle feed. This amount of cropland is sufficient to support about 15 medium-sized dairy farms. These farms, in turn, provide a livelihood for 15 farm families plus about 75 additional workers.<sup>1</sup> The farms generate

TABLE 17-3  
ABAG AND SONOMA COUNTY POPULATION PROJECTIONS

	<u>1980 County</u>	<u>1980 ABAG</u>	<u>1990 County</u>	<u>1990 ABAG</u>	<u>2000 County</u>	<u>2000 ABAG</u>	<u>2005 County</u>	<u>2005 ABAG</u>
POPULATION								
Santa Rosa & Environs								
Santa Rosa	83,320	109,150	117,000	133,000	150,000	158,900	165,000	168,700
Rural Santa Rosa	39,542	13,713	34,200	16,100	28,000	18,700	25,000	20,200
Total	<u>122,862</u>	<u>122,863</u>	<u>151,200</u>	<u>149,100</u>	<u>178,000</u>	<u>177,600</u>	<u>190,000</u>	<u>188,900</u>
Sebastopol & Environs								
Sebastopol	5,595	7,411	7,000	8,600	9,300	9,700	10,100	10,100
Rural Sebastopol	18,085	16,269	18,160	18,200	18,270	20,800	18,300	21,200
Total	<u>23,680</u>	<u>23,680</u>	<u>25,160</u>	<u>26,800</u>	<u>27,570</u>	<u>30,500</u>	<u>28,400</u>	<u>31,300</u>
Rohnert Park/Cotati & Environs								
Rohnert Park	3,475	24,541	4,600	30,400	6,200	38,800	6,700	45,000
Cotati	22,965	4,233	31,500	5,600	38,300	6,400	42,200	6,800
Rohnert Park/Cotati	26,440	28,774	36,100	36,000	44,500	45,200	48,900	51,800
Rural Rohnert Park/Cotati	5,750	487	6,000	700	6,500	1,100	6,600	1,350
Total	<u>58,630</u>	<u>29,261</u>	<u>78,200</u>	<u>36,700</u>	<u>95,500</u>	<u>46,300</u>	<u>104,400</u>	<u>53,150</u>
Study Area Total								
Cities	115,355	145,335	160,100	177,600	203,800	123,800	224,000	230,600
Unincorporated Areas	63,377	30,469	58,360	35,000	52,770	40,600	49,900	42,750
Total	<u>178,732</u>	<u>175,804</u>	<u>218,460</u>	<u>212,600</u>	<u>256,570</u>	<u>254,400</u>	<u>273,900</u>	<u>273,350</u>
Sonoma County Total								
Cities	166,452		227,050		287,900		317,500	
Unincorporated Areas	133,229		136,150		152,100		147,000	
Total	<u>299,681</u>	<u>299,681</u>	<u>363,200</u>	<u>362,650</u>	<u>440,000</u>	<u>440,800</u>	<u>464,500</u>	<u>475,950</u>

Sources: Association of Bay Area Governments, Projections '85, Oakland, 1985.  
Sonoma County, Comprehensive Planning Division, Draft "Land Use Element of the General Plan," Santa Rosa, April, 1985 and "Addendum to the General Plan Land Use Element" (no date).

TABLE 17-4  
POPULATION AND EMPLOYMENT PROJECTIONS  
1985-2010

	Average Annual Growth Rate 1985-2010	1985	1990	1995	2000	2005	2010
Cotati							
Population	1.8%	4,950	5,600	6,000	6,400	6,800	7,200
Employment <sup>1</sup>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rohnert Park							
Population	3.2%	28,900	30,400	33,400	38,800	45,000	52,200
Employment <sup>1</sup>	3.2%	11,100	13,200	14,900	16,600	18,200	20,000
Santa Rosa							
Population	2.0%	120,400	144,000	146,000	158,900	168,700	179,100
Employment	2.7%	65,100	73,700	81,700	89,700	98,600	108,400
Sebastopol							
Population	1.4%	7,800	8,600	9,200	9,700	10,100	10,500
Employment	1.7%	7,000	7,400	7,800	8,200	9,100	10,000
Total Study Area							
Population	2.1%	162,050	177,600	194,600	213,800	230,600	249,000
Employment	2.7%	83,200	94,300	104,400	114,500	125,900	138,400

<sup>1</sup>Employment estimates are available for the combined planning areas of Cotati and Rohnert Park and appear in the row for the latter community.

Sources: Association of Bay Area Governments, Projections '85.  
Sonoma County General Plan Land Use Element, Second Preliminary Draft  
(April 1986) and Amendment to the Land Use Element (no date).  
EIP Associates.  
CH2M-Hill.

about \$7.4 million per year in agricultural production; this amount generates an additional \$10.3 - \$12.9 million<sup>2</sup> in the economic chain as farmers expend money for supplies, labor, veterinary charges, product distribution, etc. The total yearly benefit to the local agricultural economy of the farms on these 4,000 acres is, therefore, \$17.7 - \$20.3 million.

### Sewer Fee Structure

Each jurisdiction within the wastewater disposal system assesses connection fees and service fees according to varying schedules (see Table 17-5). For single-family connections, the fees range from \$1,650 within the City of Santa Rosa to \$3,735 in Sebastopol. Sebastopol's fees were recently increased by 20% in anticipation of financing the treatment plant's expansion. Additional charges pay for installing new sewer lines or providing water meters. Bimonthly sewer service fees are fairly similar from city to city. For instance, Sebastopol and Cotati charge single-family residences a basic bimonthly rate of \$12.87-\$13.00 plus \$1.00-\$1.57 per thousand gallons of water usage; Rohnert Park charges a flat \$17 bimonthly fee. Santa Rosa's bimonthly rate is somewhat lower, at \$4.05 per connection, plus \$1.50 per thousand gallons of water usage. With the exception of Rohnert Park, all the cities calculate water usage (and therefore need for sewage disposal) during the the previous year's wet weather, when landscape irrigation water would not be needed; these figures are adjusted yearly.<sup>3,4,5,6</sup>

## **17.2 IMPACTS OF WASTEWATER SYSTEM OPERATION, ALL ALTERNATIVES**

### Impacts

The primary direct impact of the project on the local economy will be a temporary demand for construction workers and an increase in the number of technicians and engineers operating the expanded plant. An indirect impact of the project will be the accommodation of planned population and employment growth. For further discussion of growth impacts, see Chapter 18.

The main differences in socioeconomic impacts of the various alternatives lie in the amount of job generation estimated for each one. Table 17-6 displays a comparison of employment, households and population generated for each project alternative. Table 17-6 incorporates the assumptions that there are 1.17 workers per household and 2.54

TABLE 17-5  
RESIDENTIAL AND COMMERCIAL SEWAGE CONNECTION  
AND BIMONTHLY SERVICE FEES

<u>Connections</u>	<u>Santa Rosa</u>	<u>Sebastopol</u>	<u>Cotati</u>	<u>Rohnert Park</u>
3/4-inch <sup>1</sup>	\$1,650/\$2,550 <sup>2</sup>	\$3,735 <sup>5</sup>	\$2,600 <sup>6</sup>	\$3,000 <sup>7</sup>
Apartments	\$925/\$2,170 <sup>3</sup>	\$1,235 <sup>4, 5</sup>	\$2,600 <sup>6</sup>	\$2,000 <sup>7</sup>
Mobile Homes	\$825/\$1,905 <sup>3</sup>	N/A	N/A	\$2,000 <sup>7</sup>
<u>Service<sup>8</sup></u>				
Residential	\$4.05 + \$1.50	\$12.87 + \$1.00	\$13.00 + \$1.57	\$7.80 to \$17.00
Commercial				
Most	\$4.05 + \$1.50	\$12.87 + \$1.00	\$13.00 + \$1.57	\$14.00 + \$1.13
Food-Processing	\$4.05 + \$2.175	N/A	N/A	\$14.00 + \$1.50
Restaurant	\$4.05 + \$1.980	N/A	N/A	\$14.00 + \$1.56

<sup>1</sup> Most homes and business have 3/4-inch connections.

<sup>2</sup> Two figures are given for Santa Rosa connections; the first is the rate for addresses within the city limits and the second is the rate for addresses outside the city limits but within the service area (including South Park and Oakmont).

<sup>3</sup> Add \$18/front foot to connection fees for connecting to a sewer trunk if the developer has not installed a collecting sewer main.

<sup>4</sup> Reflects the cost of each additional connection in an R1 and R2 zone.

<sup>5</sup> Add \$65 to connection fee if the City provides a water meter.

<sup>6</sup> Assumes \$2,000 tap into a main sewer line is required.

<sup>7</sup> Add \$10,000/acre for installing new collectors in a subdivision.

<sup>8</sup> Service fees show two numbers; the first is the fixed bimonthly rate and the second is the additional rate per 1,000 gallons of water usage.

Sources: Cities of Cotati, Rohnert Park, Sebastopol and Santa Rosa.

TABLE 17-6  
JOBS, HOUSEHOLDS AND POPULATION ASSOCIATED WITH THE PROJECT

<u>Alternative</u>		<u>Employment</u>		<u>Households</u>		<u>Population</u>	
		<u>Construction</u>	<u>Operation</u>	<u>Temp.<sup>1</sup></u>	<u>Perm.</u>	<u>Temp.<sup>1</sup></u>	<u>Perm.</u>
1	Reuse at Geysers	1,090	30	470	30	1,180	90
2	Indirect Disposal to Russian River	730	40	310	30	790	90
3	Disposal to Pacific Ocean	1,160	30	500	30	1,260	90
4	Disposal to San Pablo Bay	1,160	30	500	30	1,260	90

<sup>1</sup> Assuming that construction lasts two years, these would be the households supported by construction laborers.

Sources: CH2M-Hill  
EIP Associates

persons per household in the study area; these assumptions were drawn from ABAG data. This analysis assumes that the households of workers will reflect prevailing trends.

It is likely that most of the wastewater treatment system employees already live in the study area and would therefore represent no change in local population. In the case of the construction workers, they may travel from all over Northern California for this work. Even assuming that all the construction workers would relocate to the study area with their households, they would represent only about 25% to 40% of one year's growth. This population increase would not be significant in relation to the pace of growth in the area, nor would it have a significant effect on local household income.

The local farming economy benefits, to some extent, from the City's wastewater irrigation program. Local farmland irrigation with treated wastewater would continue in the summertime under all the alternatives. Consequently, no impact is expected to the local farm economy under any of the alternatives.

Financing the construction of the treatment plant and pipeline routes to the San Pablo Bay, Pacific Ocean, Russian River or geysers would affect local sewer rates. Theoretically, capital expansions should be financed by connection charges and O&M costs should be financed with sewer service fees. However, financing a project of this size could increase connection charges to the point where the fees become counter-productive and discourage growth. It is likely, therefore, that some increases in bimonthly fees would be expected in addition to increased connection charges. Probable future connection charges and sewer services fees are shown in Table 17-7.<sup>7</sup>

### Mitigation Measures

The following mitigation measure is proposed:

- o Choose an alternative that weighs project costs together with other non-monetary criteria, thereby minimizing increased costs to rate payers.

TABLE 17-7  
ESTIMATED FUTURE RESIDENTIAL SEWER SERVICE FEES<sup>a</sup>

<u>Alternative</u>	<u>Connection Charge \$</u>	<u>Monthly Service Fee \$</u>
Alternative 1 - Reuse at Geysers	5,000 <sup>b</sup>	35 <sup>b</sup>
Alternative 2 - Indirect Disposal to Russian River	2,500	22
Alternative 3 - Disposal to Pacific Ocean	3,000	26
Alternative 4 - Disposal to San Pablo Bay	3,500	29

<sup>a</sup>Based on construction costs shown in Chapter 4.

<sup>b</sup>Assumes no reserve from sale of water to geothermal operators.

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- <sup>1</sup>"Economics of Dairy Farming on the Santa Rosa Plain," Raymond W. Gaines, January 1986.
- <sup>2</sup>Memorandum from David L. Richardson and Allan Highstreet, CH2M-Hill, July 15, 1986.
- <sup>3</sup>Judy Peterson, Account Clerk II, Finance Department, City of Cotati, telephone communication, 30 April 1986.
- <sup>4</sup>Lynn Bennett, Utility Bill Clerk, City of Rohnert Park, telephone communication, 29 April, 1986.
- <sup>5</sup>Stan Lindsay, Finance Director, City of Santa Rosa, interview, 15 April, 1986.
- <sup>6</sup>Lyle Gwyther, Accountant, Finance Department, City of Sebastopol, telephone communication, 30 April, 1986.
- <sup>7</sup>Stan Lindsay, Finance Director, City of Santa Rosa, telephone communication, October 29, 1986.



# GROWTH & SECONDARY IMPACTS



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## 18 GROWTH AND ITS EFFECTS ON THE SANTA ROSA REGION

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### 18.1 INTRODUCTION

Infrastructure expansion projects create the potential for growth-inducement when they provide capacity for land development and population increases beyond that planned for an area. The proposed Santa Rosa regional wastewater treatment and disposal system would have the potential to induce growth, if it accommodated more development than that allowed by the current General Plans of the cities served by the system. The California Environmental Quality Act requires that the growth inducing effects of proposed projects be considered in environmental impact reports.<sup>1a</sup> It should be noted, however, infrastructure projects do not, in themselves, produce growth. A multiplicity of factors including land availability, the health of the national and local economy, market forces and local plans and policies must favor growth if it is to occur.

### 18.2 SYSTEM CAPACITY

The capacity of an infrastructure improvement project determines whether it could induce growth beyond that planned. To establish an appropriate system capacity a number of factors need to be evaluated carefully. The first step is to determine the design period. The design period extends from today, until the time at which the new facilities would reach capacity and would need to be expanded again. The choice of a design period is a matter of judgement. If the design period is too short, then the facilities may need to be expanded within a few years of their original construction — usually an inefficient and expensive process. If the design period is too long, then public funds are committed to the provision of infrastructure capacity that will remain unused for many years.

The selected design period for the long-range wastewater management plan for the Santa Rosa region is 24 years — from today until the year 2010. This period was chosen because it is expected that the new facilities will not come into operation until about 1993, and it would be desirable that they provide 15 or 20 years of service before they need to be expanded again. In addition, local planning agencies rarely plan more than 20 years into the future and thus, it is difficult to assess local needs beyond that time.

The City of Santa Rosa and their consulting engineers considered, but rejected, an exception to the selected design year. Unlike wastewater treatment facilities some wastewater system components have a useful life of 50 years or more and are inherently difficult and costly to expand; pipelines and submarine outfalls are examples. It is economically efficient to size these facilities to handle whatever flow is projected during their useful lives. They could be sized to accommodate the flow projected for the year 2040. The City chose not to pursue this option for two reasons. First, it would require that population and employment projections would have to be made for the year 2040, to provide a basis for sizing wastewater system components. Because these projections would extend more than 30 years beyond the planning horizons of the communities in the service area, growth rates would have to be assumed that have no basis in public policy. Some believe that provision of wastewater disposal capacity for future growth not yet approved through the political process would tend to encourage or induce growth.

The second reason stems from the fact that the City of Santa Rosa has the ability to temporarily store large volumes of treated wastewater in its existing ponds. Depending on the alternative wastewater management system chosen, the City intends to retain some or all of the ponds in service to provide emergency storage in the event of treatment system failure. Pipelines and outfalls are usually sized to handle the peak flow of wastewater that is expected to occur during the design period. The peak flow is usually of short duration, but may be several times greater than the average dry weather flow. Thus, the time at which a pipeline reaches capacity and needs to be expanded again can be delayed if the peak flows can be temporarily stored. Because the City of Santa Rosa already has a large volume of storage available, it is expected that the pipeline life can be readily extended beyond 2010 by using the pipeline and storage conjunctively.

### 18.3 POTENTIAL FOR GROWTH-INDUCEMENT

The socioeconomic analysis in Chapter 17 of this EIR discussed potential growth within the study area, presenting both ABAG's and Sonoma County's population and employment growth projections. The planning departments of the cities served by the wastewater system agree that the ABAG projections accurately reflect trends in their areas.<sup>1,2,3,4</sup> General plans and other documents published for these cities note that maximum buildout will occur when the City population reaches 7,135 in Cotati, 36,000 in Rohnert Park, 265,000 in Santa Rosa, and 9,000 in Sebastopol.<sup>5,6,7,8</sup>

According to the ABAG projections, Santa Rosa will not approach its buildout population by the year 2005. The ABAG projections show growth in both Rohnert Park and Sebastopol after these cities reach their estimated buildout populations but, despite the discrepancy, the planners in Rohnert Park and Sebastopol believe that the projections remain valid for the following reason. ABAG projects growth on the basis of a City's sphere of influence boundary, which usually extends beyond a City's urban limit boundary. Cities sometimes annex the land within the sphere of influence line, and the two boundaries then become the same. In the meantime, however, planning documents may reflect only urban boundaries. It is likely, therefore, that the "ultimate buildout" level of a City may change over the course of two decades as the urban boundary changes.

Chapter 17 of this EIR compared the ABAG projections to the draft population projections prepared by Sonoma County as part of their General Plan update. As noted in that chapter, the two projections reach fairly similar results after adjusting for different geographical definitions of each City.

The City of Santa Rosa has determined that the expanded wastewater system should provide for current needs as well as those of the projected population to the year 2010. All the wastewater system alternatives would provide the same capacity for treating, storing and disposing of the expected amount of effluent. The City's consulting engineers have used the accepted ABAG figures to develop population projections to the year 2005, and then used a growth rate consistent with ABAG assumptions to project growth to the year 2010. Accordingly, the system capacity would be planned to handle a level of growth consistent with local plans and would therefore not be considered to be growth-inducing.

Although the wastewater management alternatives would not induce growth, they would remove an obstacle to growth. As was apparent, during the moratorium on new connections imposed by the Regional Water Quality Control Board in 1985, lack of adequate wastewater treatment and disposal facilities can constrain growth. At present, the moratorium has been lifted, contingent on the City of Santa Rosa meeting a proscribed schedule for construction of wastewater treatment and disposal improvements. When the new system is in place, the constraint on growth will be removed. It should be noted, however, that planned growth could still be constrained by lack of capacity in some other element of the urban infrastructure.

### 18.4 THE SANTA ROSA REGION IN 2010

As the communities in the Santa Rosa region continue to grow through the early part of next century, increased demands will be placed on local service providers. This chapter examines projected growth through 2010 in light of its effects on schools, water, police and fire services in the study area. It should be noted, however, that these local service impacts cannot be attributed to the wastewater management system alternatives. They are simply the consequences of planned growth.

The final portion of this chapter discusses in general terms the population and employment growth that could be expected by the mid-21st century.

#### 18.4.1 WATER

##### Sonoma County Water Agency<sup>19</sup>

The Sonoma County Water Agency acts both as a regional water planning agency and as a water supplier to entitlement cities, which include Santa Rosa, Cotati, and Rohnert Park. The Agency provides water from Warm Springs and Dry Creek, tributary to the Russian River, to the cities in the study area. The Warm Springs Dam has a firm annual yield of 120,000 acre-ft. Until recently, the Agency had water diversion rights to 35,355 acre-ft/yr of this water; on April 16, 1986, the California Water Resources Control Board increased the Agency's diversion rights to 75,000 acre-ft/yr. The Agency's annual draws in recent years have ranged from 34,000 to 44,000 acre-ft/yr; Agency officials believe that the increased water diversion rights will provide ample supply through the year 2015

and probably through 2020. Some new distribution facilities would be required in order to deliver water in the future.

### Cotati<sup>10</sup>

The City of Cotati is currently entitled to 1.7 mgd of water from the Sonoma County Water Agency, which the City uses only in an emergency. The City draws most of its water from the Santa Rosa Plain aquifer and foresees no difficulty in pumping water from that source to supply the City's needs through the year 2010.

### Rohnert Park<sup>11</sup>

The City of Rohnert Park also holds an entitlement to water from the Sonoma County Water Agency of 1.0 mgd, which the City uses primarily in the summer. The major portion of the City's water is pumped from the Santa Rosa Plain aquifer; City officials believe that this source will prove adequate through the year 2010.

### Santa Rosa<sup>12</sup>

Santa Rosa is entitled to 50 mgd of Water Agency water. The City's most recent Water Master Plan anticipates a need for only 42 mgd in the year 2000. Comparing these figures to the population and employment growth projections suggests that Santa Rosa would require 48-49 mgd of water by 2010, which could be served with the current entitlement. If necessary, there remains the option to renegotiate the City's contract with the Sonoma County Water Agency to take advantage of the Agency's increased diversion rights. The City does not draw water from wells.

### Sebastopol<sup>13</sup>

The City of Sebastopol acquires all its water from wells and recently constructed a new reservoir with 3 mgd capacity. The City believes that it can easily supply the population projected for the year 2010.

## 18.4.2 ENERGY<sup>14</sup>

Pacific Gas and Electric Company (PG & E) provides electricity and natural gas to the service area. Ample generation power exists from hydroelectric, nuclear, coal, natural gas and other fuel sources to serve the needs of Sonoma County communities in the

future. These sources are developed as demand grows, and PG & E expands the distribution system to serve development as it occurs.

#### 18.4.3 SCHOOLS

##### Cotati-Rohnert Park<sup>15</sup>

The Cotati-Rohnert Park School District is operating elementary schools at about 75% of capacity with about 3,600 students enrolled; secondary school students number about 2,600, or 85% of capacity. Growth projected through the year 2010 would more than exceed remaining capacity, requiring additional space for about 1,500 elementary school students (approximately three schools) and about 1,500 secondary school students, or 30% more space in middle and high school facilities.

##### Santa Rosa<sup>16</sup>

Santa Rosa District schools are operating at capacity now with 4,000 students enrolled in grades K-6 and 9,500 secondary students enrolled. The District is looking for new elementary school sites and expects to purchase one in 1988 and another in 1990. In the meantime, officials are required to bring in portable classrooms to house some students.

The High School District will experience a decline in enrollment for the next few years as rather small classes in grades 4, 5 and 6 move through the system, but enrollment will then increase. District officials project that the overall enrollment will increase by 5,000 students over the next five years. At the current student generation rate of .30 elementary and .25 secondary students per new household, the District can expect total enrollment increases of approximately 8,800 elementary and 7,300 secondary students by 2010. The District would need to double elementary school capacity and increase secondary school capacity by 80% over the next 25 years in order to accommodate these students.

##### Sebastopol<sup>17</sup>

Analy Union High School District is also facing an enrollment decline for the next few years but expects enrollment to stabilize and then increase around 1990. Current enrollment at Analy High School is about 1,150. By the year 2010, the District expects about 3,000 students at Analy High School, where the capacity is 1,200. The District

would need to more than double the school's capacity in order to accommodate these students.

Sebastopol Elementary Schools (unfinished pending receipt of information from the School District.)<sup>18</sup>

#### 18.4.4 FIRE PROTECTION

##### Cotati<sup>19</sup>

The Cotati Fire Protection District currently operates with three full-time paid staff and the remainder of the firefighters are volunteers. Officials are unable to project the needs of the District in 25 years because increases in the amount of calls for fire service depend on many factors, of which population increase is only one. Other factors include population density, increases in the city's area, and a rising number of emergency medical service calls.

##### Rohnert Park<sup>20</sup>

The Rohnert Park Public Safety Department provides both police and fire services within the City limits. The District currently has 38 sworn officers and just received authorization to add another 7 sworn officers to create a more active Fire Division. At a ratio of about 1.3 officers per 1,000 residents, the District would need another 20 officers by the year 2010. The District believes that an additional two fire engines may be required in the next 25 years but it will probably not need any more patrol cars, other than replacement vehicles.

##### Santa Rosa<sup>21</sup>

The Santa Rosa Fire Department currently employs 100 firefighters at a ratio of about 1.06 per 1,000 residents. Officials note that the number of calls have risen by about 20% in recent years, primarily as a result of increased medical emergency calls. Staffing has kept pace, and if the trend continues, the Department will need an additional 50 firefighters by the year 2010. The Department does not anticipate the need for significant amounts of new equipment, except perhaps one new fire engine. The District does foresee relocating an existing station or building a new one.

Sebastopol<sup>22</sup>

The Sebastopol Fire Department is a volunteer force, except for the Fire Chief. The Chief expects to continue maintaining a volunteer department in the future, but there is the possibility of requiring a paid staff in the future, especially if the City annexes a substantial amount of land. The Chief may also require an assistant to help with fire inspections and other duties. The number of service calls has been rising in recent years, primarily because of increased medical emergency calls.

## 18.4.5 POLICE PROTECTION

Cotati<sup>23</sup>

The Cotati Police Department currently operates with 10 sworn officers at a rate of about 2 officers per 1,000 people. This is higher than the average rate because of the City's small size. The City is expected to grow by less than 2,000 people by the year 2010, so the ratio of officers to residents will probably remain fairly close to what it is today. Therefore, the City will need about 4 more sworn officers and another 2 patrol cars in addition to the 6 vehicles currently in use. Department officials note that all the City offices are located in a building that the City administration is outgrowing, so they foresee a new municipal office building under construction within the next 25 years.

Rohnert Park

See discussion of Rohnert Park Public Safety Department in Section 18.3.4.

Santa Rosa<sup>24</sup>

The Santa Rosa Police Department currently operates with 117 sworn and 55 non-sworn personnel, for a total staff of 172. There are currently about 1.2 officers per thousand residents, but police officials believe that this rate will increase in the future to about 1.24. At that rate, the Department will need to add about 60 officers and 30 non-sworn employees to serve the projected year 2010 city population. The Police Department has recently relocated to a new facility that has been designed to accommodate growth and can house approximately 300 employees, so there is no immediate need for new office space. The Police Department currently owns 53 automobiles and 6 motorcycles; the

Department will probably need to acquire another 7 cars and 2 more motorcycles in the future.

### Sebastopol<sup>25</sup>

The Sebastopol Police Department currently employs about 13 sworn and 11 non-sworn personnel at a rate of about 2.1 officers per thousand residents. At the same rate in the year 2010, the Department will require an additional 5 sworn and 4 non-sworn employees. For that number of officers, Department officials foresee doubling the number of police vehicles for a total of 10. Department officials also note that a new police facility is in the planning stages.

### **18.5 THE SANTA ROSA REGION IN THE MID-21ST CENTURY**

The wastewater treatment and disposal system would be sized to accommodate sewage flows through the year 2010. With some modification to the planned system, however, sewage flows from year 2040 could be treated and disposed. It is instructive, therefore, to examine past growth rates in an attempt to gain some perspective for the future.

The average annual population growth rate in the study area is expected to be 2.15% between 1985 and 2010. Assuming that this growth rate would remain constant into the future, the year 2040 population would be 353,300. This amount would be slightly more than twice the current population. The estimated 2040 employment total would be 204,600, based on an average annual growth rate of 2.65% between 1985 and 2040. This amount would be two and one-half times the present employment.

Both the population and employment growth rates are well below historic long-term growth rates for other fast-growing Northern California communities. Santa Clara County, for example, sustained a 5.1% annual population growth rate between 1960 and 1980, but the 40-year growth rate (1960-2000) is projected to be 3.6%. Employment in that county grew at an average annual rate of 7.5% for a 10-year period, but long-term employment growth through the year 2000 would produce an average annual employment growth rate of 4.75%.

The Santa Rosa region may not experience the sudden surge of employment and population expansion that occurred in Santa Clara County, but the region is enjoying a healthy pace of growth. It is reasonable, therefore, to assume that 2.15% and 2.65% average annual population and employment growth rates could be sustained in the long term.

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<sup>1a</sup>Section 15126(g) of CEQA guidelines states that an EIR must "Discuss the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment."

<sup>1</sup>Wayne Goldberg, Director of Community Development, City of Santa Rosa, interview, April 18, 1986.

<sup>2</sup>Paul Skanchy, Planning Director, City of Rohnert Park, telephone communication, April 24, 1986.

<sup>3</sup>Bruce Aspinall, City Planner, City of Sebastopol, telephone communication, April 24, 1986.

<sup>4</sup>Dennis Dorch, Planning Director, City of Cotati, telephone communication, April 24, 1986.

<sup>5</sup>City of Cotati, General Plan, adopted September 22, 1981.

<sup>6</sup>City of Rohnert Park, Housing Element of the General Plan, adopted May 9, 1983.

<sup>7</sup>CH2M-Hill, Trunk Sewer Capacity Evaluation for the City of Santa Rosa, June 1986.

<sup>8</sup>City of Sebastopol, General Plan, adopted April 26, 1982

<sup>9</sup>Robert Cortelyou, Engineer, Sonoma County Water Agency, telephone communications, April 9, April 29 and November 3, 1986.

<sup>10</sup>Steve Nelson, Public Works, City of Cotati, telephone communication, April 29, 1986.

<sup>11</sup>Paul Skanchy, Planning Director, City of Rohnert Park, telephone communication, April 29, 1986.

<sup>12</sup>Milan Ward, Water Service Supervisor, City of Santa Rosa, telephone communication, May 1, 1986.

- <sup>13</sup>Paul Schoch, City Engineer, City of Sebastopol, telephone communication, April 30, 1986.
- <sup>14</sup>Brad Crotteau, Planning Distribution Engineer, PG & E, telephone communication, April 28, 1986.
- <sup>15</sup>Sharon Dulberg, Superintendent's Office, Cotati-Rohnert Park Unified School District, telephone communications, April 28 and October 29, 1986.
- <sup>16</sup>Don Moore, Deputy Superintendent, Analy Union High School District, telephone communication, April 28, 1986.
- <sup>18</sup>(in process)
- <sup>19</sup>Bill Deas, Assistant Chief, Cotati Fire Protection District, telephone communication, April 28, 1986.
- <sup>20</sup>Bob Dennett, Director of Public Safety, City of Rohnert Park, telephone communication, April 28, 1986.
- <sup>21</sup>Tony Pini, Chief, Santa Rosa Fire Department, telephone communication, April 28, 1986.
- <sup>22</sup>Russ Shura, Chief, Sebastopol Fire Department, telephone communication, April 28, 1986.
- <sup>23</sup>Lt. Robert Stewart, Police Department, City of Cotati, telephone communication, April 28, 1986.
- <sup>24</sup>Sgt. Byron McLennan, Police Department, City of Santa Rosa, telephone communications, April 28 and May 1, 1986.
- <sup>25</sup>Charles Baker, Chief of Police, City of Sebastopol, telephone communication, April 29, 1986.





# GENERAL ENVIRONMENTAL CONSIDERATIONS



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## **19 OTHER ENVIRONMENTAL CONSIDERATIONS**

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### **19.1 INTRODUCTION**

The California Environmental Quality Act requires that a number of factors, other than those discussed in earlier chapters, be considered in an EIR. They are discussed below.

### **19.2 NO PROJECT ALTERNATIVE**

If the City of Santa Rosa chose not to improve the regional wastewater management system, then occasional violations of the City's discharge requirements would continue. Treatment capacity would be limited to that available today. Under these circumstances the Regional Water Quality Control Board would likely impose a moratorium on new connections to the system and, perhaps, fine the City of Santa Rosa for its permit violations.

Without additional wastewater treatment and disposal capacity the General Plans of the communities in the wastewater service area could not be implemented. It is likely that growth would be directed to other nearby areas that could be served by new separate wastewater systems. The pressure to build separate systems would probably increase. Separate systems would likely be inferior from an environmental point-of-view and their existence would encourage development that is not in conformity with land use plans.

### **19.3 SIGNIFICANT ADVERSE EFFECTS THAT CANNOT BE AVOIDED**

The California Environmental Quality Act requires that significant adverse environmental effects that cannot be avoided must be identified in an EIR on a proposed project. Section 15002(g) of the State's guidelines for implementing the California Environmental Quality Act states that "A significant effect on the environment is defined as a substantial adverse change in the physical conditions which exist in the area affected by the proposed project."

Based on this definition, none of the wastewater management alternatives would have a significant adverse effect on the environment. All four alternatives would have to comply with stringent state and federal regulations promulgated to protect water quality, public health and aquatic life.

Although there is no scientific evidence to suggest that discharge of secondary-treated wastewater to the ocean through a long submarine outfall would be harmful to the marine environment, some may feel that the introduction of such a discharge to an area currently free of direct wastewater discharge is in itself a significant impact. In the same way, some may feel that disposal of highly treated wastewater to a river that serves as a source of drinking water supply is a significant impact even if there is no evidence that the practice adversely affects public health.

#### **19.4 CUMULATIVE IMPACTS**

Because there are no other discharges of wastewater to either the Geysers geothermal area or the Pacific Ocean between Bodega Bay and the Russian River, Alternatives 1 and 3 would not add to an existing adverse impact. There would, consequently, be no cumulative effects.

Indirect discharge of wastewater to the Russian River would contribute to the overall volume of wastewater discharged to the river from a variety of sources. Although indirect discharge would not be expected to have a significant adverse impact on river water quality, as discussed in Chapter 6, the Santa Rosa region's discharge would represent the largest of the municipal wastewater discharges.

Municipal wastewater discharges upstream of the present Santa Rosa discharge include Ukiah, Hopland, Healdsburg, Windsor, Cloverdale and Calpella. Upstream industrial discharges include a forest products mill in Ukiah and a number of sand and gravel companies. Downstream discharges include Forestville, Occidental, Guerneville and Monte Rio. In addition, river water quality is affected by urban storm runoff and failing septic tanks.

Discharge of treated wastewater to San Pablo Bay would contribute to the total volume of wastewater discharged to the San Francisco Bay system, although it would represent only

about 5% of the total. The San Francisco Bay system has been subjected to many man-induced changes including municipal and industrial wastewater discharge, diversion of freshwater inflow from the Sacramento and San Joaquin rivers, dredging and filling of wetlands and introduction of exotic biotic species. Although the more obvious pollution problems have been corrected over the last 30 years as a result of a massive program of wastewater facility construction, a number of problems remain. The striped bass fishery continues to decline, the sediments in some areas contain high levels of toxic metals and the shellfish remain unsuitable for human consumption.

In the next decade, it is likely that extensive studies will be made to determine the causes of the remaining problems. If municipal wastewaters are found to be one of the causes of pollution then a discharge from the Santa Rosa region would contribute to the cumulative effect.

### **19.5 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY**

None of the alternatives involve short-term use or exploitation of the natural environment at the expense of long-term productivity. An exception is the continued use of treated wastewater for pasture irrigation. Over a long period of time, probably more than 100 years, metals could accumulate in the upper layers of soil until concentrations are reached that would inhibit agricultural productivity. In the same way, metals would accumulate in the soil layers underlying the rapid infiltration system until at some point the system would have to be rebuilt at a new location.

### **19.6 IRREVERSIBLE ENVIRONMENTAL CHANGES**

The alternative wastewater management systems would have useful lives of between 50 and 100 years. If, after that period, the technology embodied by the alternatives has become obsolete, then they could be replaced by newer wastewater disposal methods. The structural components of the alternatives could be removed and the land-use and visual quality impacts identified in this report could be eliminated.

Although none of the alternatives are expected to have adverse consequences for the aquatic environment, experience at other locations has shown that most of the changes

that result from wastewater discharge can be reversed in a short period of time. Exceptions are contamination of groundwater and the introduction of persistent toxic materials into the food chain.

Construction of the new facilities represents an irreversible commitment of most of the materials and all of the energy involved in their construction.



# SOLIDS HANDLING IMPROVEMENTS



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## 20 SOLIDS HANDLING IMPROVEMENTS

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### 20.1 INTRODUCTION

The City of Santa Rosa's engineering consultant has recommended a long-range wastewater solids or sludge management plan that involves changing from the present practice of landfilling sludge to processing for agricultural use. The processing could be undertaken by a private entity or by the City. The goal would be to eliminate landfilling by the early 1990s.

In addition to the long-range plan some immediate improvements must be made to the solids handling facilities at the Laguna treatment plant. The improvements would be made in 1987, several years before the long-term wastewater management plan can be implemented. This chapter describes the long-range plan and the immediate improvements and their potential environmental impacts.

### 20.2 LONG-RANGE PLAN

#### PROJECT DESCRIPTION AND SETTING

Wastewater sludge is a by-product of wastewater treatment. It is soupy liquid that consists of 95-percent water and 5-percent sewage solids. In 1985, the Laguna treatment plant produced about 400 tons of sludge each day with a dry solids content of 20 tons. By 2010, sludge production will have increased to 720 tons each day with a dry solids content of 36 tons. At present, sludge is dewatered to 17-percent solids and trucked to the Central Sonoma County landfill.

The proposed plan is to beneficially use the sludge for agricultural purposes. Two ways of using the sludge could occur. The first and preferable option would be for a private entity to accept the dewatered sludge, process it and market it as a soil amendment, fertilizer or potting soil. Two private companies have expressed an interest in the sludge. Before

this option would be implemented, pilot-scale testing would be undertaken and long-term contracts negotiated with the private entities. An 8-acre paved site would be provided by the City for sludge processing. The location of the site has not yet been determined.

If private processing of sludge for sale proved infeasible then the City would implement its own agricultural use program. The City would truck dewatered sludge to the lands of cooperating farmers and apply it at an average rate of 5 dry tons per acre per year. A total of 2,250 acres of land would be required. During periods of wet weather, when sludge could not be applied to the land, it would be stored in the existing sludge ponds.

## IMPACTS OF SYSTEM OPERATION

### Impacts

Because sewage sludge can contain trace quantities of toxic materials it could have an adverse effect on soils, crops and consumers of crops. In order to ensure that no threat is posed to public health, the California State Department of Health Services has established guidelines for agricultural use of sludge that incorporate federal regulations on the same subject.<sup>1</sup> The guidelines include limitations on the maximum amounts of lead, cadmium and PCBs that can be contained in sludge used in distribution and marketing. CH2M-Hill reports that sludge from the Santa Rosa regional system meets the requirements.<sup>2</sup>

It is not possible to know where the processed sludge might be applied to the land after it is processed and sold by private operators. Because the product would comply with Department of Health Service guidelines for toxic materials content it is very unlikely that the use of sludge would introduce toxic materials into the soil or crops in damaging quantities. In addition the price of sludge sold in bags or in bulk to farmers would probably preclude its application to land in quantities that could adversely affect soil or crop quality.

If the City implemented its own agricultural use project it would have to comply with federal regulations designed to prevent the introduction of cadmium into the food chain. It is also assumed that it would follow the Department of Health Service's recommendations with respect to nitrogen application and the cumulative application of heavy metals to agricultural lands. If nitrogen is applied to the land in quantities in

excess of crop requirements then the excess nitrogen may percolate downward and contribute to the pollution of groundwater bodies. Similarly, if heavy metals are applied to soils in large quantities, they may be taken up by crops. To ensure that all regulations and recommendations with respect to application rates are met, the City's program would limit the sludge application rate to 5 dry tons per acre per year. In addition, a number of restrictions on use of land would be complied with. No planting of food crops that are consumed unprocessed would be permitted for three years after sludge application. No planting of food crops subject to processing before consumption would be permitted for 18 months. No grazing of dairy animals would be permitted for 12 months and no use of the land by other animals used for food would be permitted within one month of sludge application. Public access to the land would be prohibited for 12 months after sludge application.

Because the sludge management system proposed for the Santa Rosa regional system would comply with all applicable environmental regulations there is no reason to believe that it would have an adverse effect on the environment. Reuse of the type proposed would involve a slightly greater risk to the environment than a pure disposal mode such as landfilling. On the other hand, it would make beneficial use of the plant nutrient content of the sludge rather than simply throwing it away.

### Mitigation Measures

The following mitigation measures are suggested:

- o Sludge quality should be routinely monitored to ensure that it meets all requirements for agricultural use.
- o The contributing communities' industrial pretreatment programs should be aggressively implemented to prevent toxic materials from entering the sewer system and, hence becoming part of the sludge.
- o Bagged, processed sludge offered to the public for sale could be labeled as not recommended for use on food crops.

### IMPACTS OF SYSTEM CONSTRUCTION

Implementation of the long-range sludge management plan would involve only minor construction. While the location and exact nature of the needed facilities cannot be

determined at present, the impacts associated with their construction would also probably be minor.

### 20.3 IMMEDIATE IMPROVEMENTS

#### PROJECT DESCRIPTION AND SETTING

All of the proposed improvements would be made within the boundaries of the Laguna treatment plant. Principal improvements would be the construction of gravity belt sludge thickeners, an anaerobic sludge digester and a sludge dewatering facility. Their locations at the treatment plant are shown in Figure 20-1.

The gravity belt thickeners would be used to reduce the water content of waste activated sludge from the secondary treatment units so that it is more suitable for digestion. The anaerobic digester would increase the plant's capacity to digest sludge; that is to convert it from an offensive, rapidly decaying material to a stable earth-smelling substance. The sludge dewatering facility would reduce the volume and water content of the sludge making it suitable for truck transport to a sanitary landfill.

#### IMPACTS OF SYSTEM OPERATION

##### Impacts

The proposed improvements would eliminate the need to temporarily store digested sludge and thus would reduce the potential for odor generation. There would be no adverse effects of system operation.

##### Mitigation Measures

None are suggested.

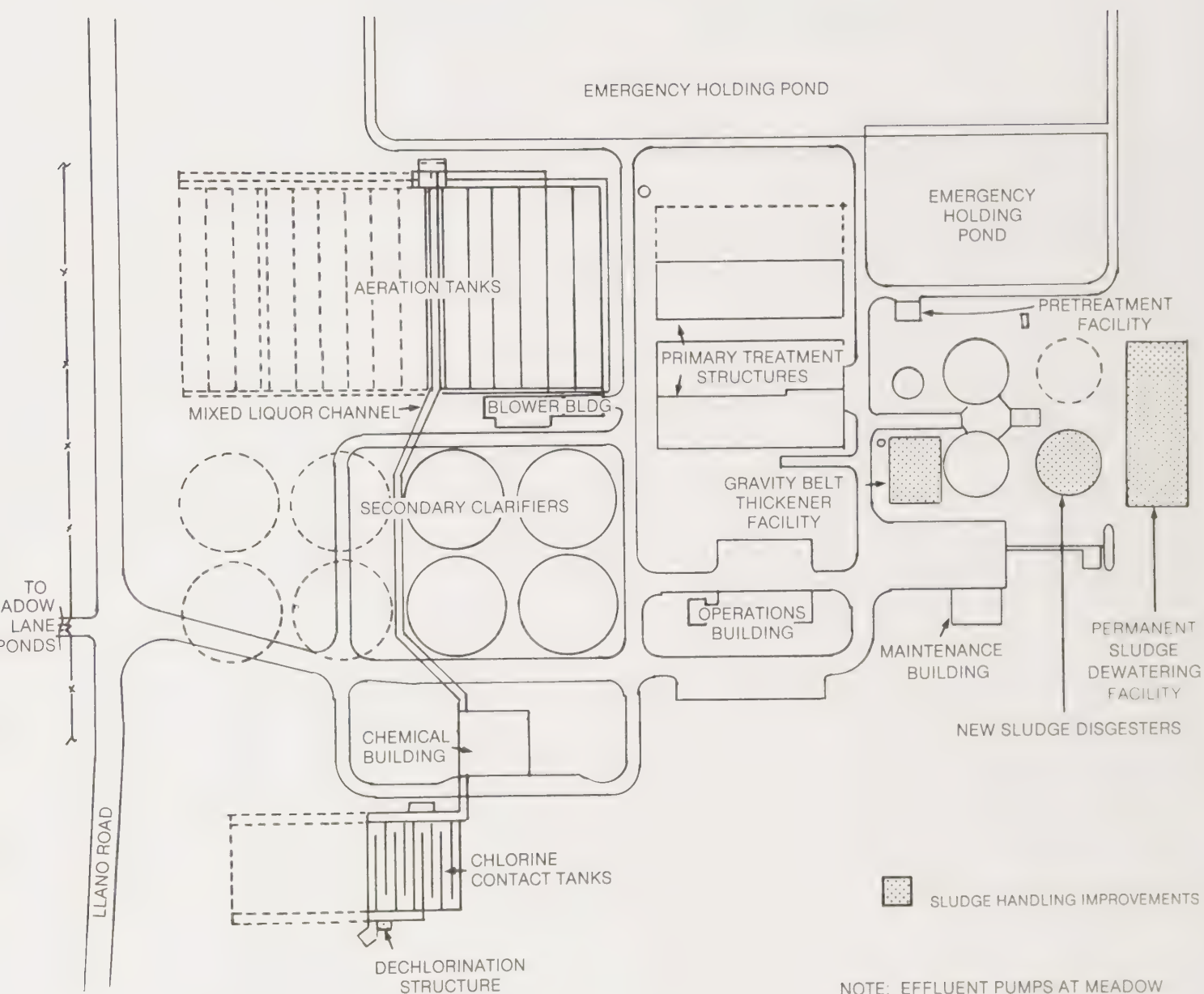
#### IMPACTS OF SYSTEM CONSTRUCTION

##### Impacts

Construction activities would increase noise and dust levels at the treatment plant. Commuting construction workers and materials deliveries would increase the number of vehicle movements on Llano Road. Workers' vehicles could be accommodated in the existing parking lot.

# SOLIDS HANDLING IMPROVEMENTS AT LAGUNA WASTEWATER TREATMENT PLANT

FIGURE 20-1



Mitigation Measures

The following mitigation measures are suggested:

- o Construction work should be limited to ordinary working hours, weekdays from 7 a.m. to 6 p.m.
- o During grading and other dust generating activities, exposed ground surfaces should be sprayed with water.

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<sup>1</sup>Guide for Landspreading Use of Sewage Sludge, California Department of Health Services, 1980, revised 1981.

<sup>2</sup>Long-term Study of Treatment and Disposal Alternatives for Santa Rosa Subregional Wastewater System, CH2M-Hill, 1986.

**APPENDIX A**  
**WASTEWATER DISPOSAL AND THE ENVIRONMENT**



## APPENDIX A

### WASTEWATER DISPOSAL AND THE ENVIRONMENT

#### INTRODUCTION

There is no perfect solution to the wastewater disposal problem. If there was, every community, including Santa Rosa would adopt it. Instead there is a range of alternative solutions, all with certain advantages and disadvantages. It is the importance of these advantages and disadvantages, examined in the context of a particular situation, that determine the merit of an alternative solution — the "goodness" of fit.

Before considering the Santa Rosa region's wastewater disposal options and their environmental consequences, it is profitable to review them at a more conceptual level. Obviously, the Santa Rosa region is not the first area to face difficult choices with respect to wastewater disposal. There is a large body of knowledge and experience, accumulated at other locations, that is helpful in reviewing the options for Santa Rosa. In addition, any option must be viewed within its regulatory context — both State and Federal governments have been active in regulating waste disposal practices. The following paragraphs describe the nature of sewage, the effects of sewage constituents on the environment and the technology employed to eliminate or lessen environmental effects. The discussion of technical matters is prefaced by a brief history of wastewater disposal practices and regulation.

#### HISTORY

Prior to about 1860, sanitary wastes from American homes were disposed of in pit privies. The householder rather than local government was responsible for waste disposal. In a dispersed farming economy few problems resulted. As the economy of the United States began to change, in the latter half of the last century, from primarily agriculture to a mixture of agriculture and industry, the cities began to grow. In the crowded conditions of the city, the pit privy was no longer a satisfactory method of waste disposal. The ground became saturated with sewage, wells were contaminated and the health of the urban population, particularly the poor, declined.

Although, at the time, scientists did not understand that microbes or germs were the cause of most diseases, studies in London in the 1860's had proved that drinking polluted water often led to sickness. Recognizing that the problem could never be corrected by individual householders acting alone, many city governments took over responsibility for water supply and sewage disposal. In the last years of the nineteenth century and the early decades of this century, many cities undertook ambitious public works programs designed to bring pure drinking water to their citizens and to collect and dispose of sewage safely.

The basic principle adhered to in designing the first sewage systems was that sewage should be collected and conveyed to a location where human contact with it was unlikely. This was usually a nearby stream or river, an estuary or the ocean. Little thought was given to the environmental consequences, which were frequently disastrous. In San Francisco Bay, a once flourishing commercial shellfishing industry was destroyed. At many inland locations fish and other aquatic life were eliminated from streams and rivers.

Until the 1940's and 1950's, State and Federal authorities took little action to prevent water pollution and what action was taken was designed to protect public health rather than the environment. Local governments sometimes acted to control water pollution but were rarely required to by the State or Federal governments. In the late 1960's and 1970's, both State and Federal legislators, responding to public concern, passed laws designed to curb water pollution. The Federal Water Pollution Control Act Amendments of 1972 radically altered wastewater disposal practices in the United States.

One of the Act's provisions was that all municipal wastewater discharges should receive, at least, secondary treatment before discharge to rivers or the ocean. Secondary treatment was required, as a minimum irrespective of the ultimate disposal site. The legislation did not take account of the fact that some receiving environments, a mountain stream, for example, are less able to assimilate pollutants, without harm, than a large river or the ocean. Legislators believed that it was better to have a law that was simple to administer, because it applied the same standard to all discharges, rather than a more complex law that allowed for variations depending on the nature of the receiving environment. Because at the time of passage of the Act, only 10% to 20% of wastewaters generated in the United States received secondary treatment, a nationwide construction program was initiated by the new law.

California's legislators adopted a different approach. The Porter-Cologne Act of 1969 required that water quality control plans be prepared for each major drainage basin in the State. These plans, known as basin plans, provide the technical basis for regulatory action by Regional Water Quality Control Boards. Unlike the Federal legislation, the basin plans do take account of the special characteristics of the water bodies that might receive waste discharges. In most cases, the basin plan requires secondary or tertiary treatment before discharge, although they do allow less than secondary treatment for ocean discharges. From the point of view of a community seeking to meet all applicable discharge requirements the most stringent of the two regulations, Federal or State, must be complied with.

Non-point source water pollution, that is, pollution caused by harmful substances emanating from a large area rather than from a single discharge point, were addressed in plan, known as a 208 plan, prepared by the Association of Bay Area Governments. Examples of non-point pollutant sources are urban stormwater runoff and agricultural irrigation return flow.

Today, almost all municipal wastewater discharges in California, including Santa Rosa's are subject to secondary treatment. The exceptions are some discharges to the ocean which may be granted a waiver from secondary treatment requirements under certain conditions.

## **WASTEWATER CONSTITUENTS AND THE ENVIRONMENT**

### **WASTEWATER CONSTITUENTS**

Wastewater is potable water to which certain substances have been added as a result of human use. Some of these substances are harmful to human beings and the environment. It is because of these potentially harmful substances that the water is now considered to be sewage or wastewater.

Table A-1 shows some of the substances added to water by human use, their sources and their potential effects, if discharged untreated to the environment.

A unique aspect of municipal wastewater, and one that makes it difficult to treat and dispose of, is its variability. Most people view the sewer as the ultimate disposal point for

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TABLE A-1  
UNTREATED MUNICIPAL WASTEWATER AND THE ENVIRONMENT

Wastewater Constituent	Source	Potential Environmental Effects
Organic Matter	Feces, food preparation waste, soap, restaurants	Oxygen depletion leading to fish kills, etc.
Microbes	Feces	Disease transmission
Salts	Feces, industries water softeners	Negligible, but make water less suitable for reuse
Plant Nutrients	Feces, food preparation waste	Excessive growth of aquatic plants, groundwater pollution
Ammonia	Urine	Toxic effects on aquatic life
Metals	Plumbing fixtures, industries	Toxic effects on aquatic life, some bioaccumulation
Synthetic Organics (Pesticides, Herbicides, Industrial Cleaners)	Illicit chemical disposal, industries, household cleaners	Toxic effects on aquatic life, some bioaccumulation

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substances they no longer require. It is difficult to control what enters the sewer system and consequently just about any substance known to man may arrive at a municipal wastewater treatment plant.

## POTENTIAL ENVIRONMENTAL EFFECTS OF UNCONTROLLED WASTEWATER DISCHARGE

Discharge of untreated municipal wastewater to the environment produces a variety of effects, most of them adverse. Usually wastewaters are discharged to water bodies, although sometimes they are disposed of on land.

When raw municipal wastewaters are discharged into streams, rivers or the ocean, the severity of the adverse effects depends to a considerable extent on the amount of dilution that occurs. If little dilution is available, as might be expected in a small stream, then the adverse effects are obvious. The stream is contaminated with bacteria and other microbes and becomes offensive to eye and nose. Rapid bacterial growth, fueled by the abundant organic material in the wastewater, uses up the oxygen dissolved in the stream water. Because fish and most other forms of aquatic life need oxygen they are destroyed or harmed. Oxygen depletion never occurs in the ocean, and rarely in large rivers, as a result of wastewater discharge, because dilution is so great.

Some of the large numbers of bacteria, viruses and other microbes present in sewage can cause disease in man. If sewage-polluted river water is used, untreated, for potable water supply the health of consumers will be endangered. The more common waterborne diseases are salmonellosis, typhoid fever, cholera and giardiasis. It has been suggested that the health of bathers in sewage-polluted waters could also be compromised, although there is little scientific evidence to support the hypothesis.

Untreated wastewaters may contain various materials that are toxic to aquatic life. Whether a particular wastewater stream is toxic to aquatic life will depend on the concentrations of the various substances. Many substances which are harmless, or sometimes even beneficial, at low concentrations, are toxic at higher concentrations. Ammonia is commonly found in wastewater in concentrations that are toxic to aquatic life. Potentially toxic metals and synthetic organics are also commonly found in wastewater, but not usually at toxic concentrations.

A few toxic materials are subject to the phenomenon of bioaccumulation. Bioaccumulation occurs when certain types of organisms concentrate materials in their bodies as a result of their feeding habits, or when the toxic substances become progressively more concentrated as they move through the food web. Many shellfish feed by filtering planktonic organisms from water they pump through their bodies. This method of feeding can lead to accumulation of toxic materials in shellfish tissue. Another example of bioaccumulation was the reproductive failure of the California Brown Pelican as a result of high concentrations of DDT in some of its organs. DDT, discharged to the ocean in agricultural runoff and municipal wastewater at low concentrations was gradually concentrated as it moved through the food web until it reached levels that were deleterious to the health of some species of fish-eating birds.

The plant nutrient content of wastewater can be problematical in certain types of water bodies. It is well known that wastewater has value as fertilizer — this characteristic is used to advantage when wastewaters are reused for agricultural irrigation. In rivers and lakes, the nutrients in discharged wastewater may produce excessive growth of algae and other aquatic plants.

When wastewaters are discharged to the land few adverse impacts are apparent if application rates are low enough to prevent runoff and deep percolation. Any underlying groundwater bodies may be polluted by microbes, nitrates and toxic materials, all of which would make the groundwaters unsuitable for use as potable water suppliers without extensive treatment.

## **REGULATIONS**

Because the adverse environmental effects of uncontrolled wastewater disposal are unacceptable to society, both the State and Federal government have promulgated regulations that wastewater dischargers must comply with. The regulations vary depending on the nature of the environment affected by the discharge. In general, two kinds of regulations must be met, effluent limits and water quality standards. Effluent limits are standards that apply to the discharge as it leaves the wastewater system and enters the environment; they are sometimes known as "end-of-the-pipe" standards. Water quality standards specify the quality of water that must be maintained in the environment, in order to support designated beneficial uses. The beneficial uses of a water body are those uses that the State has determined must be protected.

Because the wastewater system alternatives being considered by the City of Santa Rosa involve several different disposal modes, the regulations that must be met vary widely. The specific regulations that each alternative must meet are outlined in the next chapter. In general, the regulations require that the adverse environmental impacts of uncontrolled wastewater disposal, described previously, be eliminated or lessened by the application of appropriate wastewater management technology.

## **WASTEWATER MANAGEMENT TECHNOLOGY**

The polluting potential of wastewater constituents can be eliminated or greatly reduced by careful management. The wastewater manager has three means of altering the characteristics of the waste stream — source control, treatment and dispersion. Santa Rosa's present system employs all three, as do most of the alternatives being considered for the future.

### **SOURCE CONTROL**

Some substances that are harmful to the environment are not removed or are only partly removed by conventional wastewater treatment processes. Some of these substances also disrupt the treatment processes, themselves. Examples are certain metals and synthetic organic compounds. The best method for controlling these substances is to prevent their entry into the sewage system. This can be done by enforcing a sewer ordinance that prohibits the discharge of toxic or otherwise harmful substances and requires that industries pretreat their wastes before discharge to the sewer.

The City of Santa Rosa operates a source control program which applies to all communities contributing to the regional system. The program is described in the City's operating manuals.

### **TREATMENT**

Wastewater treatment can remove many substances from the wastewater stream that have the potential to harm the environmental. Some of the characteristics of typical municipal wastewater before and after treatment are shown in Table A-2. Many physical and chemical processes are employed at a wastewater treatment plant; they can be divided into four groups.

TABLE A-2  
WASTEWATER CHARACTERISTICS

<u>Constituent</u>	<u>Units</u>	<u>Untreated Sewage</u>	<u>Secondary Effluent</u>	<u>Tertiary<sup>1</sup> Effluent</u>
Suspended Solids	mg/l	220	30	5
BOD <sup>2</sup>	mg/l	220	30	5
Total Nitrogen	mg/l	40	20	5
Ammonia	mg/l	25	15	2
Total Phosphorus	mg/l	8	6	2
Total Coliform Bacteria <sup>3</sup>	MPN/100ml	100,000,000	23	2

<sup>1</sup> Assumes secondary treatment plus nutrient removal and filtration.

<sup>2</sup> Biochemical oxygen demand is a measure of the wastewater's ability to cause oxygen depletion in the receiving waters.

<sup>3</sup> Coliform bacteria counts provide an indicator of the possible presence of disease-causing organisms. Coliforms do not themselves produce disease in humans.

Primary treatment is designed to remove suspended or floating material that could cause aesthetic offense in the receiving waters. It also removes about 40% of the organic matter that could cause oxygen depletion in rivers or streams and some metals and synthetic organics.

Secondary treatment, which is almost always a biological process, removes most of the remaining dissolved and suspended organic matter and varying amounts of metals and synthetic organics.

Tertiary or advanced wastewater treatment is any process beyond secondary treatment. Advanced wastewater treatment systems can be designed to remove various wastewater constituents depending on the need in particular circumstances.

Regardless of the level of treatment employed, treatment plant effluent is almost always disinfected before discharge to the environment. Disinfection destroys bacteria and other microbes in the effluent.

It should be noted, however, that wastewater treatment does not destroy most pollutants (microbes are an exception); they are simply separated from the water that makes up the bulk of municipal sewage. The pollutants are retained in the sludge, which must also be disposed of in some way. The fourth category of treatment, sludge treatment is designed to make the sludge easier to dispose of. The sludge or solids handling process at the treatment plant often represent more than 50% of the total capital investment.

## DISPERSION

The potentially-adverse environmental effects of certain wastewater constituents can be reduced by dispersion in the environment. Many substances that are harmful at high concentrations are innocuous or much less harmful at low concentrations. In the case of disposal to a water body, the discharge is usually made in a manner that maximizes rapid mixing of wastewater in the receiving waters. Ocean discharges, for example, are usually made through long submarine pipelines or outfalls, terminating several thousand feet from the shore. At the end of the outfall is a diffuser, a section of pipe, usually several hundred feet long, with small openings or ports through which wastewater is discharged. Similar systems can be used to disperse wastewaters in lakes, estuaries or large rivers. In

small rivers, where the wastewater discharge may represent a substantial proportion of the total flow, mixing is induced by the turbulence caused by the discharge.

Disposal of wastewaters by agricultural irrigation also disperses wastewater constituents widely. Some substances are broken down by soil bacteria, others are used as nutrients by plants and still others percolate into the groundwater or are retained in the soil.

**APPENDIX B**  
**BIOTIC SPECIES LISTS**



TABLE B-1  
COMMERCIAL AND SPORT FISHERIES OF THE SONOMA COAST<sup>1</sup>

<u>Fish</u>	<u>Species</u>	<u>Commercial<sup>2</sup></u> <u>(Operation/Season)</u>	<u>Sport<sup>3</sup></u> <u>(Type)</u>
	Chinook (King) Salmon	troll/April 15 - Sept. 30 (5-30 fathoms)	hook-and-line
	Silver (Coho) Salmon	troll/April 15 - Sept. 30 (5-30 fathoms)	hook-and-line
	Dover Sole	trawl/year long (290-350 fathoms)	
	Petrale Sole	trawl/year long (50-90 fathoms)	
	English Sole	trawl/year long (40-80 fathoms)	
	Rex Sole	trawl/year long (50-100 fathoms)	
	Sandab	"	
	Sand Sole	"	
	Calif. Halibut	"	
	Rockfish Bocaccio Chilipepper Splitnose Widow Speckled	trawl/year long (80-120 fathoms)	hook-and-line
	Sablefish	trawl/year long (290-350 fathoms)	
	Lingcod	trawl/year long	hook-and-line

TABLE B-1 (continued)

<u>Fish</u>	<u>Species</u>	<u>Commercial<sup>2</sup></u> <u>(Operation/Season)</u>	<u>Sport<sup>3</sup></u> <u>(Type)</u>
	Misc. Trawl Caught Species	trawl/year long <del>50-100</del> 100 fathoms) Skate Pacific hake White croaker	
	Anchovy	roundhaul nets/May-July (<20 fathoms)	
<u>Crustaceans</u>			
	Market Crab	trap/mid Nov. - June (5-40 fathoms)	
		trawl (limit of 500 lbs/landing)	
	Shrimp	trawl/(May - Oct.) (40-65 fathoms)	
<u>Mollusk</u>			
	Oyster	Culture	
	Abalone		Diving (free)
	Clams		Digging

<sup>1</sup>Odemar, M.W. et. al. A Survey of the Marine Environment from Fort Ross, Sonoma Co. to Point Lobos, Monterey Co. 1968.

<sup>2</sup>Trawl: Otter trawl employs a net in the form of a flattened bag that is dragged across the ocean bottom.

Troll: Towing a lure through the water.

Roundhaul: Purse seine and lampara nets which are long, movable nets with floats along the upper edge and weights along the lower margin.

Trap: Baited traps or "pots" left one to three days in water depths of 5 - 40 fathoms.

Culture: Seed or juvenile oysters are attached to the surface of a "mother shell" and then placed in sand or mudflats or suspended from racks or floating rafts.

<sup>3</sup>Hook-and-line: partyboats, skiff, shore and pier fishing.

Free diving: diving with no external air supply

TABLE B-2  
WATERBIRD SPECIES LIST OF THE SAN FRANCISCO BAY REGION

Waterbirds that commonly use San Francisco Bay as part of the Pacific Flyway and a few resident non-migratory Bay region species.

Habitat Key:

- O/NS -- Ocean, near shore
- B/L -- Bay and lagoons
- TM/S -- Tidal mud and sandflats
- RS -- Rocky shores including breakwater
- SP -- Salt ponds or salt evaporators
- L/P -- Lakes and ponds
- S/SM -- Salt or brackish water marsh
- FWM -- Fresh water marsh
- GR -- Grassland near water source
- MAN -- Manmade habitats (garbage dumps, harbors or piers)

\*resident non-migratory Bay region species

COMMON NAME	SCIENTIFIC NAME	AREAS OF SUITABLE HABITATS
Common Loon	<u>Gavia immer</u>	O/NS, B/L, L/P
Arctic Loon	<u>Gavia arctica</u>	O/NS, B/L
Red-throated Loon	<u>Gavia stellata</u>	O/NS, B/L
Western Grebe	<u>Aechmophorus occidentalis</u>	O/NS, B/L, SP
Red-necked Grebe	<u>Podiceps grisegena</u>	B/L
Horned Grebe	<u>Podiceps auritus</u>	B/L
Eared Grebe	<u>Podiceps nigricollis</u>	B/L, SP
Pied-billed Grebe	<u>Podilymbus podiceps</u>	B/L, SP, L/P
American White Pelican	<u>Pelecanus erythrorhynchos</u>	SP, L/P
Brown Pelican	<u>Pelecanus occidentalis</u>	O/NS, B/L
Brandt's Cormorant	<u>Phalacrocorax penicillatus</u>	B/L, RS
Double-crested Cormorant	<u>Phalacrocorax auritus</u>	SP, L/P, FWM
Pelagic Cormorant	<u>Phalacrocorax pelagicus</u>	B/L, RS
Great Egret	<u>Casmerodius albus</u>	B/L, TM/S, SP, L/P, S/EM, FWM
Snowy Egret	<u>Egretta thula</u>	B/L, TM/S, SP, L/P, FWM
Great Blue Heron	<u>Ardea herodias</u>	all areas except O/NS
Black-crowned Night Heron	<u>Nycticorax nycticorax</u>	B/L, TM/S, SP, L/P, S/EM, FWM, MAN
American Bittern	<u>Botaurus lentiginosus</u>	S/EM, FWM
Tundra Swan	<u>Cygnus columbianus</u>	SP, L/P, S/EM, FWM
Canada Goose	<u>Branta canadensis</u>	B/L, SP, L/P, S/EM, FWM
Brant	<u>Branta bernicla</u>	O/NS
White-fronted Goose	<u>Anser albifrons</u>	L/P, FWM, GR
Snow Goose	<u>Chen caerulescens</u>	L/P, FWM
Mallard	<u>Anas platyrhynchos</u>	B/L, TM/S, SP, L/P, S/EM, FWM, GR, MAN
Northern Pintail	<u>Anas acuta</u>	B/L, TM/S, SP, L/P, S/EM, FWM, GR
Gadwall	<u>Anas strepera</u>	B/L, TM/S, SP, L/P, S/EM, FWM, GR
American Wigeon	<u>Anas americana</u>	B/L, TM/S, SP, L/P, S/EM, FWM, GR
Northern Shoveler	<u>Anas clypeata</u>	B/L, TM/S, SP, L/P
Cinnamon Teal	<u>Anas cyanoptera</u>	B/L, TM/S, SP, L/P, S/EM, FWM

Green-winged Teal	<u>Anas crecca</u>	B/L, TM/S, SP, L/P, S/BM, FWM
Wood Duck	<u>Aix sponsa</u>	L/P
Redhead	<u>Aythya americana</u>	O/NS, L/P
Canvasback	<u>Aythya valisineria</u>	B/L, TM/S
Ring-necked Duck	<u>Aythya collaris</u>	L/P
Greater Scaup	<u>Aythya marila</u>	B/L
Lesser Scaup	<u>Aythya affinis</u>	B/L, SP, L/P
Common Goldeneye	<u>Bucephala clangula</u>	B/L, SP
Barrow's Goldeneye	<u>Bucephala islandica</u>	B/L
Bufflehead	<u>Bucephala albeola</u>	B/L, SP, L/P
Black Scoter	<u>Melanitta nigra</u>	O/NS, B/L
White-winged Scoter	<u>Melanitta fusca</u>	O/NS, B/L
Surf Scoter	<u>Melanitta perspicillata</u>	O/NS, B/L
Red-breasted Merganser	<u>Mergus serrator</u>	B/L, SP
Common Merganser	<u>Mergus merganser</u>	L/P, FWM
Ruddy Duck	<u>Oxyura jamaicensis</u>	B/L, SP, L/P, FWM
Black-shouldered Kite	<u>Elanus caeruleus</u>	S/BM, FWM, GR
Northern Harrier	<u>Circus cyaneus</u>	S/BM, FWM, GR
Virginia Rail	<u>Rallus limicola</u>	S/BM, FWM
Sora	<u>Porzana carolina</u>	S/BM, FWM
Black Rail	<u>Laterallus jamaicensis</u>	S/BM
*Clapper Rail	<u>Rallus longirostris</u>	S/BM
Common Moorhen	<u>Gullinula chloropus</u>	L/P, FWM
American Coot	<u>Fulica americana</u>	B/L, TM/S, SP, L/P, S/BM, FWM, GR, MAN
Black-bellied Plover	<u>Pluvialis squatarola</u>	TM/S, SP, GR
Snowy Plover	<u>Charadrius alexandrinus</u>	TM/S, SP
Semipalmated Plover	<u>Charadrius semipalmatus</u>	TM/S, SP
Killdeer	<u>Charadrius vociferus</u>	GR, MAN
Am. Black Oystercatcher	<u>Haematopus bachmani</u>	RS
American Avocet	<u>Recurvirostra americana</u>	TM/S, SP, L/P, S/BM, FWM
Black-necked Stilt	<u>Himantopus mexicanus</u>	TM/S, SP, S/BM, FWM
Marbled Godwit	<u>Limosa fedoa</u>	TM/S, SP
Long-billed Curlew	<u>Numenius americanus</u>	TM/S, S/BM, GR
Whimbrel	<u>Numenius phaeopus</u>	TM/S, RS, S/BM, GR
Greater Yellowlegs	<u>Tringa melanoleuca</u>	TM/S, L/P, S/BM, FWM
Willet	<u>Catoptrophorus semipalmatus</u>	TM/S, SP, S/BM, GR
Spotted Sandpiper	<u>Actitis macularia</u>	RS, MAN
Wandering Tattler	<u>Heteroscelus incanus</u>	RS
Short-billed Dowitcher	<u>Limnodromus griseus</u>	TM/S, SP, S/BM, FWM
Long-billed Dowitcher	<u>Limnodromus scolopaceus</u>	TM/S, SP, S/BM, FWM
Wilson's Phalarope	<u>Phalaropus tricolor</u>	B/L, SP
Red Phalarope	<u>Phalaropus fulicarius</u>	B/L, SP
Red-necked Phalarope	<u>Phalaropus lobatus</u>	B/L, SP, L/P
Common Snipe	<u>Gallinago gallinago</u>	S/BM, FWM, GR
Surfbird	<u>Aphriza virgata</u>	RS
Ruddy Turnstone	<u>Arenaria interpres</u>	TM/S, RS, SP
Black Turnstone	<u>Arenaria melanocipha</u>	TM/S, RS, SP
Red Knot	<u>Calidris canutus</u>	TM/S, SP
Dunlin	<u>Calidris alpina</u>	TM/S, SP, S/BM
Sanderling	<u>Calidris alba</u>	TM/S
Least Sandpiper	<u>Calidris minutilla</u>	TM/S, RS, SP, S/BM, FWM
Western Sandpiper	<u>Calidris mauri</u>	TM/S, S/BM
Parasitic Jaeger	<u>Stercorarius parasiticus</u>	O/NS, B/L, TM/S
Glaucous-winged Gull	<u>Larus glaucescens</u>	O/NS, TM/S, RS, SP, L/P, GR, MAN
Western Gull	<u>Larus occidentalis</u>	O/NS, B/L, TM/S, RS, SP, GR, MAN
Herring Gull	<u>Larus argentatus</u>	all areas except FWM

California Gull	<u>Larus californicus</u>	all areas
Ring-billed Gull	<u>Larus delawarensis</u>	B/L, TM/S, L/P, S/BM, GR, MAN
Mew Gull	<u>Larus canus</u>	O/NS, B/L, TM/S, L/P, MAN
Heermann's Gull	<u>Larus heermanni</u>	O/NS, B/L, TM/S, RS, MAN
Bonaparte's Gull	<u>Larus philadelphia</u>	O/NS, B/L, TM/S, SP, L/P
Least Tern	<u>Sterna antillarum</u>	B/L, SP
Common Tern	<u>Sterna hirundo</u>	B/L, S/BM
Forster's Tern	<u>Sterna forsteri</u>	O/NS, B/L, TM/S, SP, L/P, S/BM, FWM
Elegant Tern	<u>Sterna elegans</u>	O/NS, B/L, TM/S, RS
Caspian Tern	<u>Sterna caspia</u>	O/NS, B/L, SP
Black Tern	<u>Chlidonias niger</u>	B/L, SP, L/P
Common Murre	<u>Uria aalge</u>	O/NS, B/L, RS
Pigeon Guillemot	<u>Cephus columba</u>	O/NS, B/L, RS
*Belted Kingfisher	<u>Ceryle alcyon</u>	B/L, RS, L/P, MAN
*Marsh Wren	<u>Cistothorus palustris</u>	S/BM, FWM
Savannah Sparrow	<u>Passerculus sandwichensis</u>	S/BM, FWM
*Song Sparrow	<u>Melospiza melodia</u>	S/BM

Source: Oceanic Society, The Changing Bay, 1984

TABLE B-3  
PLANTS OF LAGUNA DE SANTA ROSA

Taken from a list compiled by Nancy Harrison for the California Native Plant Society. This list includes plants that are typical of vernal pools, grassland, and various woodland communities.

Athyrium Filix-femina v. sitchense (Lady Fern)  
Aster chilensis (Wild Aster)  
Anthemis Cotula (Mayweed)  
Alisma triviale (Native Water Plantain)  
Alisma lanceolatum (Intro.)  
Anagallis arvensis (Scarlet Pimpernel)  
Atriplex patula ssp. hastata (Saltbush)  
Amaranthus Powellii (Common Redroot)  
Aesculus californica (Buckeye)  
Azolla filiculoides (Duckweed Fern)  
Aira carvophyllea (Hairgrass)  
Alopecurus aequalis v. sonomensis (Foxtail) Rare  
Alopecurus Howellii (Foxtail)  
Brodiaea hyacinthina (White Brodiaea)  
Brodiaea peduncularis  
Brodiaea terrestris (Dwarf Brodiaea)  
Boisduvalia densiflora  
Boisduvalia glabella  
Boisduvalia stricta  
Barbarea orthoceras (Winter Cress)  
Baccharis Douglasii  
Brassica ssp. (Wild Mustard)  
Briza minor (Small Quaking Grass)  
Carex stipata (Sedge)  
Carex Tracyi  
Carex obnupta  
Carex densa  
Carex barbarae  
Carex Cusickii  
Carex Hassei  
Cammassia Quamash  
Crataegus Douglasii (Native Hawthorne)  
Cornus californica (Dogwood)  
Centaureum floribundum  
Cirsium vulgare (Thistle)  
Cicuta Douglasii (Water Hemlock)  
Chlorogalum pomeridianum (Soap plant)  
Cyperus niger (Umbrella Sedge)  
Convolvulus arvensis (Bindweed)  
Chenopodium spp. (Figweeds)  
Chenopodium ambrosioides (Mexican Tea)  
Cotula coronopifolia (Brass Buttons)

Calochortus uniflorus (Star Tulip)  
Calandrinia ciliata Menziesii (Red Maids)  
Callitriche marginata (Water Starwort)  
Deschampsia danthonoides (Hairgrass)  
Dipsacus fullonum (Teasel)  
Daucus Carota (Wild Carrot)  
Danthonia californica  
Downingia concolor (vp's)  
Equisetum arvense (Horsetail)  
Epilobium spp. (Willow Herbs)  
Eryngium armatum (Bee-Thistle)  
Eryngium aristulatum (Bee-Thistle)  
Euphorbia serpyllifolia (Spurge)  
Eschscholzia californica (California poppy)  
Erodium spp. (Filaree)  
Eragrostis hyonoides (Teal Grass)  
Fraxinus latifolia (Oregon Ash)  
Festuca arundinacea (Fescue - Alta)  
Foeniculum sp. (Fennel)  
Galium tridium (Cleavers)  
Galium spp. (Cleavers)  
Geranium dissectum (Wild Geranium)  
Glyceria elata  
Gnaphalium purpureum (Purple Cudweed)  
Gnaphalium chilense (Common Cudweed)  
Gnaphalium palustre  
Grindelia sp.  
Glyceria occidentalis (Manna Grass)  
Gratiola ebracteata  
Holcus lanatus (Velvet Grass)  
Hypericum anagalloides (Tinker's Penny)  
Hypericum perforatum (Klamath Weed)  
Hemizonia congesta (Tarweed)  
Hemizonia sp.  
Hypochoeris glabra  
Helenium puberulum (Sneezeweed)  
Hordeum hystrix (Wild Barley)  
Hordeum brachyantherum (Barley)  
Humulus Lupulus (Hops)  
Heleocharis rostellata (Walking Sedge)  
Holocarpha virgata (Tarweed)  
Isoetes Howellii (Quillwort) Rare  
Juncus phaeocephalus  
Juncus effusus v. pacificus  
Juncus dubius  
Juncus Bolanderi  
Juncus bufonius (Toadrush)  
Juncus occidentalis  
Juncus oxymeris  
Jussiaea repens v. peploides (Aquatic)  
Kickxia Elatine (Scropan) (Fluellin)  
Luzula spp. (Woodrush)

Lotus Purshianus (Spanish Clover)  
Lotus corniculatus (Birdsfoot Trefoil)  
Lemna minor (Duckweed)  
Lippia nodiflora (Lippia)  
Lythrum Hyssopifolia (Loosestrife)  
Lonicera involucrata (Twinberry)  
Leontodon nudicaulis (Hawkbit)  
Linum angustifolium (Blue Flax)  
Lathyrus sp. (Pea)  
Lolium multiflorum (Rye)  
Lactuca spp. (Wild Lettuce)  
Limnanthes vincularis (Rare Meadow Foam) Rare  
Limnanthes Douglasii & ssp. (Meadow Foam)  
Lilaea scilloides (Flowering Quillwort)  
Myrica californica (Wax Myrtle)  
Mentha pulegium (Pennyroyal)  
Mimulus guttatus (Monkeyflower)  
Myriophyllum brasiliense (Braz. Milfoil)  
Madia sativa (Common Tarweed)  
Marrubium vulgare (Horehound)  
Medicago hispida (Bur-Clover)  
Melilotus albus (White Melilot)  
Melilotus indicus (Yellow Melilot)  
Matricaria matricarioides (Pineapple Weed)  
Marah sp. (Wild Cucumber)  
Machaerocarpus californicus (Star Water Plantain)  
Myosurus minimus (Mousetail)  
Marsilea vestita (Clover Fern)  
Nasturtium officinale (Watercress)  
Navarretia squarrosa (Skunkweed)  
Oenanthe sarmentosa (Water Parsley)  
Polygonum hydrobiperoides  
Plantago major (Common Plantain)  
Plantago lanceolata (Buckhorn)  
Polypogon monspeliensis (Common Beardgrass)  
Phalaris arundinacea (Reed Canary Grass)  
Picris echioides (Ox Tongue)  
Perideridia Gairdneri (Yampah) Rare  
Poa annua (Annual Bluegrass)  
Plagiobothrys sp. (Marsh Popcorn Flower)  
Pleuropogon californicus (Semaphore Grass)  
Popogyne Douglasii parviflora (Popogyne)  
Quercus lobata (Valley Oak)  
Rumex crispus (Curley Dock)  
Rumex conglomeratus (Dock)  
Rumex pulcher (Fiddle Dock)  
Rumex Acetosella (Sheep Sorrel)  
Rumex salicifolius (complex) (Native Dock)  
Rubus procerus (Himalaya Berry)  
Rubus vitifolius (Native Blackberry)  
Rosa sp. (intro) (Rose)  
Rhus diversiloba (Poison Oak)

Ranunculus californicus (Cal. Buttercup)  
Ranunculus Lobbii (Aquatic Buttercup)  
Ranunculus muricatus (Spiny Buttercup)  
Ranunculus sp. (Buttercup)  
Ranunculus Bloomeri (Bloomer's Buttercup)  
Ribes divaricatum (Gooseberry)  
Rapbanus sativus (Wild Radish)  
Rorippa curvisiliqua (Yellow Cress)  
Sisyrinchium bellum (Blue-eyed Grass)  
Sisyrinchium californicum (Yellow-eyed Grass)  
Sonchus asper (Sow Thistle)  
Sagittaria sp. (Arrowhead)  
Salix spp. (Willows)  
Scirpus acutus (Common Tule)  
Scirpus microcarpus (Bulrush)  
Scirpus cernuus (Small Bulrush)  
Scirpus koilolepis (Small Bulrush)  
Scirpus fluviatilis (River Bulrush) Rare  
Sparganium eurycarpum (Bur-reed)  
Sparganium multipedunculatum (Bur-Reed) Rare  
Sium suave (Water Parsnip)  
Solidago occidentalis (Western Goldenrod)  
Silene gallica (Windmill Pink)  
Stachys rigida quercetorum (Hedge Nettle)  
Stachys Chamissonis (Coast Nettle)  
Stachys ajugoides (Hairy Nettle)  
Sidalcea malvaeflora (Common Checker)  
Sidalcea diploscypha (Checker)  
Solanum nodiflorum (Nightshade)  
Sagina occidentalis (Pearlwort)  
Spergularia rubra (Pink Spurrey)  
Soliva sessilis (Comp)  
Sherardia arvensis (Field Madder)  
Symphoricarpos rivularis (Snowberry)  
Trifolium Wormskioldii (Cow Clover)  
Trifolium repens (White Clover)  
Trifolium appendiculatum (Clover)  
Trifolium gracilentum  
Trifolium subterraneum (Underground Clover)  
Trifolium barbigerum  
Trifolium depauperatum (Small Clover)  
Trifolium variegatum (White-Tip Clover)  
Typha latifolia (Cattail)  
Tragopogon porrifolius (Oyster Plant)  
Taraxacum vulgare (Dandelion)  
Tillaea aquatica (Pigmy Weed)  
Urtica holosericea (Stinging Nettle)  
Veronica americana (Am. Brooklime)  
Veronica Anagallis-aquatica (Eur. Brooklime)  
Veronica peregrina (Speedwell)  
Vicia dasycarpa (Purple Vetch)  
Vicia sativa (Spring Vetch)

Vicia angustifolia (Vetch)  
Wyethia glabra (Mule's Ears)  
Wyethia angustifolia (Narrow leaved Mule's Ears)  
Xanthium strumarium v. canadense (Common Cocklebur)

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Source: County of Sonoma, Laguna de Santa Rosa Environmental  
Analysis and Management Plan, 1977

TABLE B-4

## LIST OF BIRDS SIGHTED NEAR THE LAGUNA DE SANTA ROSA

A species list based on 20 years of observation by the late Gordon L. Bolander, a resident of the area.

<u>SPECIES</u>	<u>STATUS</u>
Common Loon	<u>Gavia immer</u> W Rare
Horned Grebe	<u>Podiceps auritus</u> W Rare
Red-throated Loon	<u>Gavia stellata</u> W, A
Eared Grebe	<u>Podiceps caspicus</u> W
Western Grebe	<u>Aechmophorus occidentalis</u> W
Pied-billed Grebe	<u>Podilymbus podiceps</u> R, B
White Pelican	<u>Pelecanus erythrorhynchos</u> Rare
Double-crested Cormorant	<u>Phalacrocorax auritus</u> W
Great Blue Heron	<u>Ardea herodias</u> R, B
Green Heron	<u>Butorides virescens</u> S
Cattle Egret	<u>Bubulus ibis</u> W, Rare
Great Egret	<u>Ardea occidentalis</u> R
Snowy Egret	<u>Leucophovx thula</u> R
Black-crowned Night Heron	<u>Nycticorax nycticorax</u> R, B
American Bittern	<u>Botaurus lentiginosus</u> R, B
Whistling Swan	<u>Olor columbianus</u> W, M
* Trumpeter Swan	<u>Olor buccinator</u> W
Canada Goose	<u>Branta canadensis</u> W, M
Black Brant	<u>Branta nigricans</u> Rare
White-fronted Goose	<u>Anser albifrons</u> W
Snow Goose	<u>Chen hyperborea</u> M
Ross Goose	<u>Chen rossii</u> W, A
Mallard	<u>Anas platyrhynchos</u> R, B
Gadwall	<u>Anas strepera</u> W
Pintail	<u>Anas acuta</u> W
Green-winged Teal	<u>Anas carolinensis</u> W
Blue-winged Teal	<u>Anas discors</u> S, B
Cinnamon Teal	<u>Anas cyanoptera</u> S, B
American Wigeon	<u>Mareca americana</u> W
Northern Shoveler	<u>Spatula clypeata</u> W
Wood Duck	<u>Aix sponsa</u> R, B
Redhead	<u>Aythya americana</u> W
Ring-necked duck	<u>Aythya collaris</u> W
Canvasback	<u>Aythya valisineria</u> W
Greater Scaup	<u>Aythya marila</u> W
Lesser Scaup	<u>Aythya affinis</u> W
Common Goldeneye	<u>Bucephala clangula</u> W
Bufflehead	<u>Bucephala albeola</u> W
White-winged Scoter	<u>Melanitta deglandi</u> W, Rare
Surf Scoter	<u>Melanitta perspicillata</u> W, A

<u>SPECIES</u>	<u>STATUS</u>
Ruddy Duck	W
Hooded Merganser	W
Common Merganser	M
Turkey Vulture	R
White-tailed Kite	R, B
Goshawk	V, Rare
Sharp-shinned Hawk	W
Cooper's Hawk	W
Red-tailed Hawk	R
Red-shouldered Hawk	R
Rough-legged Hawk	M
Ferruginous Hawk	M, Rare
Golden Eagle	Rare
* Bald Eagle	W, Rare
Marsh Hawk	W
Osprey	M
* Prairie Falcon	Rare
* Peregrine Falcon	Rare
Merlin	W, M
American Kestrel	R
California Quail	R
Ring-necked Pheasant	R
Virginia Rail	
Sora	Rare
Common Gallinule	W
American Coot	W
Semipalmated Plover	M, Rare
Killdeer	R, B
Black-bellied Plover	M
Common Snipe	W
Long-billed Curlew	M
Whimbrel	M
Spotted Sandpiper	W, M
Solitary Sandpiper	W, M, Rare
Greater Yellowlegs	M
Lesser Yellowlegs	M, Rare
Pectoral Sandpiper	M, Rare
Least Sandpiper	M
Dunlin	M
Short-billed Dowitcher	M
Long-billed Dowitcher	M
Western Sandpiper	M
Sanderling	M, A
American Avocet	M, Rare
Black-necked Stilt	M, Rare
Red Phalarope	Rare
Wilson's Phalarope	M, Rare
Northern Phalarope	M
Glaucous-winged Gull	W
Western Gull	Rare
<u>Oxyura jamaicensis</u>	
<u>Lophodytes cucullatus</u>	
<u>Mergus merganser</u>	
<u>Cathartes aura</u>	
<u>Elanus leucurus</u>	
<u>Accipiter gentilis</u>	
<u>Accipiter striatus</u>	
<u>Accipiter cooperii</u>	
<u>Buteo jamaicensis</u>	
<u>Buteo lineatus</u>	
<u>Buteo lagopus</u>	
<u>Buteo regalis</u>	
<u>Aquila chrysaetos</u>	
<u>Haliaeetus leucocephalus</u>	
<u>Circus cyaneus</u>	
<u>Pandion haliaetus</u>	
<u>Falco mexicanus</u>	
<u>Falco peregrinus</u>	
<u>Falco sparverius</u>	
<u>Lophortyx californicus</u>	
<u>Phasianus colchicus</u>	
<u>Rallus limicola</u>	
<u>Porzana carolina</u>	
<u>Gallinula chloropus</u>	
<u>Fulica americana</u>	
<u>Charadrius semipalmatus</u>	
<u>Charadrius vociferus</u>	
<u>Squatarola squatarola</u>	
<u>Capella gallinago</u>	
<u>Numenius americanus</u>	
<u>Numenius phaeopus</u>	
<u>Actitis macularia</u>	
<u>Tringa solitaria</u>	
<u>Totanus melanoleucus</u>	
<u>Totanus flavipes</u>	
<u>Erolia melanotos</u>	
<u>Erolia minutilla</u>	
<u>Erolia alpeina</u>	
<u>Limnodromus griseus</u>	
<u>Limnodromus scolopaceus</u>	
<u>Ereunetes mauri</u>	
<u>Crocethea alba</u>	
<u>Recurvirostra americana</u>	
<u>Himantopus mexicanus</u>	
<u>Phalaropus fulicarius</u>	
<u>Steganopus tricolor</u>	
<u>Lobipes lobatus</u>	
<u>Larus glaucescens</u>	
<u>Larus occidentalis</u>	

<u>SPECIES</u>		<u>STATUS</u>
Herring Gull	<u>Larus argentatus</u>	W
California Gull	<u>Larus californicus</u>	W
Ring-billed Gull	<u>Larus delawarensis</u>	W
Mew Gull	<u>Larus canus</u>	W
Bonaparte's Gull	<u>Larus philadelphia</u>	M
Forster's Tern	<u>Sterna forsteri</u>	M
Caspian Tern	<u>Hydroprogne caspia</u>	M
Black Tern	<u>Chidonias niger</u>	A
Band-tailed Pigeon	<u>Columba fasciata</u>	M
Rock Dove	<u>Columba livia</u>	R
Mourning Dove	<u>Zenaidura macroura</u>	R
Roadrunner	<u>Geococcyx californianus</u>	A
Barn Owl	<u>Tyto alba</u>	R
Screech Owl	<u>Otus asia</u>	R
Great Horned Owl	<u>Bubo virginianus</u>	R
Pygmy Owl	<u>Glaucidium gnoma</u>	A
Burrowing Owl	<u>Speotyto cunicularia</u>	Rare
Spotted Owl	<u>Strix occidentalis</u>	V, A
Long-eared Owl	<u>Asio otus</u>	M, Rare
Short-eared Owl	<u>Asio flammeus</u>	W
Saw-whet Owl	<u>Aegolius acadicus</u>	W
Common Nighthawk	<u>Chordeiles minor</u>	A
Vaux's Swift	<u>Chaetura vauxi</u>	M
White-throated Swift	<u>Aeronavtes sakatalis</u>	M
Anna's Hummingbird	<u>Calypste anna</u>	R
Rufous Hummingbird	<u>Selasphorus rufus</u>	M
Allen's Hummingbird	<u>Selasphorus sasin</u>	S
Calliope Hummingbird	<u>Stellula calliope</u>	M, Rare
Belted Kingfisher	<u>Megaceryle alcyon</u>	R
Common Flicker	<u>Colaptes cafer</u>	R
Pileated Woodpecker	<u>Dryocopus pileatus</u>	V, Rare
Acorn Woodpecker	<u>Melanerpes formicivorus</u>	R
Lewis Woodpecker	<u>Asyndesmus lewis</u>	M
Yellow-bellied Sapsucker	<u>Sphyrapicus varius</u>	W
Hairy Woodpecker	<u>Dendrocopos villosus</u>	V
Downy Woodpecker	<u>Dendrocopos pubescens</u>	R
Nuttall's Woodpecker	<u>Dendrocopos nuttallii</u>	R
Western Kingbird	<u>Tyrannus verticalis</u>	M
Ash-throated Flycatcher	<u>Myiarchus cinerascens</u>	S
Black-Phoebe	<u>Sayornis nigricans</u>	R
Say's Phoebe	<u>Sayornis saya</u>	W
Willow Flycatcher		M
Western Flycatcher	<u>Empidonax difficilis</u>	S
Olive-sided Flycatcher	<u>Nuttallornis borealis</u>	S
Western Wood Pewee	<u>Contopus sordidulus</u>	S
Horned Lark	<u>Eremophila alpestris</u>	V, Rare
Violet-green Swallow	<u>Tachycineta thalassina</u>	M, B
Tree Swallow	<u>Iridoprocne bicolor</u>	S, W
Rough-winged Swallow	<u>Stelgidopteryx ruficollis</u>	S
Barn Swallow	<u>Hirundo rustica</u>	S

<u>SPECIES</u>		<u>STATUS</u>
Cliff Swallow	<u>Petrochelidon pyrrhonota</u>	S
Purple Martin	<u>Progne subis</u>	M
Steller's Jay	<u>Cyanocitta stelleri</u>	W
Scrub Jay	<u>Apelocoma coerulescens</u>	R
Yellow-billed Magpie	<u>Pica nuttalli</u>	A
Common Raven	<u>Corvus corax</u>	V
Common Crow	<u>Corvus brachyrhynchos</u>	R
Chestnut-backed Chickadee	<u>Parus rufescens</u>	R
Plain Titmouse	<u>Parus inornatus</u>	R
Bushtit	<u>Psaltiriparus minimus</u>	R
White-breasted Nuthatch	<u>Sitta carolinensis</u>	R
Red-breasted Nuthatch	<u>Sitta canadensis</u>	W
Pygmy Nuthatch	<u>Sitta pygmaea</u>	V, Rare
Brown Creeper	<u>Certhia familiaris</u>	R
Wrentit	<u>Chamaea fasciata</u>	R
House Wren	<u>Troglodytes aedon</u>	M
Winter Wren	<u>Troglodytes troglodytes</u>	W
Bewick's Wren	<u>Thryomanes bewickii</u>	R
Long-billed Marsh Wren	<u>Cistothorus platensis</u>	R
Mockingbird	<u>Mimus polyglottos</u>	R
California Thrasher	<u>Toxostoma redivivum</u>	R
American Robin	<u>Turdus migratorius</u>	R
Varied Thrush	<u>Ixoreus naevius</u>	W
Hermit Thrush	<u>Hylocichla guttata</u>	W
Swainson's Thrush	<u>Hylocichla ustulata</u>	S
Western Bluebird	<u>Sialia mexicana</u>	R
Blue-gray Gnatcatcher	<u>Polioptila caerulea</u>	M
Golden-crowned Kinglet	<u>Regulus satrapa</u>	W
Ruby-crowned Kinglet	<u>Regulus calendula</u>	W
Water Pipit	<u>Anthus spinoletta</u>	W
Cedar Waxwing	<u>Bombycilla cedrorum</u>	W
Northern Shrike	<u>Lanius excubitor</u>	W, Rare
Loggerhead Shrike	<u>Lanius ludovicianus</u>	R
Starling	<u>Sturnus vulgaris</u>	R
Hutton's Vireo	<u>Vireo huttoni</u>	R
Solitary Vireo	<u>Vireo solitarius</u>	M
Warbling Vireo	<u>Vireo gilvus</u>	S
Black and White Warbler	<u>Mniotilta varia</u>	Rare, M
Tennessee Warbler	<u>Vermivora peregrina</u>	Rare, M
Orange-crowned Warbler	<u>Vermivora celata</u>	S
Nashville Warbler	<u>Vermivora ruficapilla</u>	M
Yellow Warbler	<u>Denfroica petechia</u>	S
Yellow-rumped Warbler		W
Northern Parula Warbler	<u>Parula americana</u>	M, Rare
Black-throated gray Warbler	<u>Dendroica nigrescens</u>	M
Townsend's Warbler	<u>Dendroica Townsendi</u>	W
Hermit Warbler	<u>Dendroica occidentalis</u>	M
Chestnut-sided Warbler	<u>Dendroica pensylvanica</u>	M, Rare
Blackpoll Warbler	<u>Dendroica striata</u>	M, Rare
McGillivray's Warbler	<u>Oporornis tolmiei</u>	M

<u>SPECIES</u>		<u>STATUS</u>
Common Yellowthroat	<u>Geothlypis trichas</u>	S
Yellow-breasted Chat	<u>Icteria virens</u>	S
Wilson's Warbler	<u>Wilsonia pusilla</u>	S, M
American Redstart	<u>Setophaga ruticilla</u>	M, Rare
House Sparrow	<u>Passer domesticus</u>	R
Western Meadowlark	<u>Sturnella neglecta</u>	R
Yellow-headed Blackbird	<u>Xanthocephalus xanthocephalus</u>	M, Rare
Red-winged Blackbird	<u>Agelaius phoeniceus</u>	R
Tri-colored Blackbird	<u>Agelaius tricolor</u>	V
Northern Oriole		S
Brewer's Blackbird	<u>Euphagus cyanocephalus</u>	R
Brown-headed cowbird	<u>Molothus ater</u>	R
Western Tanager	<u>Piranga ludoviciana</u>	S
Summer Tanager	<u>Piranga rubra</u>	M
Black-headed Grosbeak	<u>Pheucticus melanocephalus</u>	S
Blue Grosbeak	<u>Guiraca caerulea</u>	V, Rare
Lazuli Bunting	<u>Passerina amoena</u>	M
Painted Bunting	<u>Passerina ciris</u>	A
Evening Grosbeak	<u>Hesperiphona vespertina</u>	W
Purple Finch	<u>Carduelis purpureus</u>	R
House Finch	<u>Carduelis mexicanus</u>	R
Pine Siskin	<u>Spinus pinus</u>	R
American Goldfinch	<u>Spinus tristis</u>	R
Lesser Goldfinch	<u>Spinus psaltria</u>	R
Lawrence's Goldfinch	<u>Spinus lawrencei</u>	S
Red Crossbill	<u>Loxia curvirostra</u>	W
Green-tailed Towhee	<u>Chlorura chlorura</u>	A
Rufous-sided Towhee	<u>Pipilo erythrophthalmus</u>	R
Brown Towhee	<u>Pipilo fuscus</u>	R
Savannah Sparrow	<u>Passerculus sandwichensis</u>	W
Lark Sparrow	<u>Chondestes grammacus</u>	M
Dark-eyed Junco		W
Chipping Sparrow	<u>Spizella passerina</u>	S
White-crowned Sparrow	<u>Zonotrichia leucophrys</u>	W
Golden-crowned Sparrow	<u>Zonotrichia atricapilla</u>	W
White-throated Sparrow	<u>Zonotrichia albicollis</u>	W
Fox Sparrow	<u>Passerella iliaca</u>	W
Lincoln's Sparrow	<u>Melospiza lincolni</u>	W
Swamp Sparrow	<u>Melospiza georgiana</u>	W, Rare
Song Sparrow	<u>Melospiza melodia</u>	R
Stilt Sandpiper	<u>Micropalama himantopus</u>	A
Yellow Billed Cuckoo	<u>Coccyzus americanus</u>	

- R - Resident year round  
 S - Summer resident  
 W - Winter resident  
 B - Breeding  
 M - Migrant  
 V - Vagrant  
 A - Accidental  
 \* - Endangered Species

Source: County of Sonoma, Laguna de Santa Rosa Environmental Analysis and Management Plan, 1977.

TABLE B-5  
FISHES OF THE RUSSIAN RIVER SYSTEM

Family Petromyzontidae--lampreys	
<u>Lampetra ayresii</u> (river lamprey)	A,N
<u>L. pacifica</u> (Coastrange brook lamprey)	R,N
<u>L. tridentata</u> (Pacific lamprey)	A,N
Family Acipenseridae--sturgeons	
<u>Acipenser medirostris</u> (green sturgeon)	A,N
<u>A. transmontanus</u> (white sturgeon)	A,N
Family Clupeidae--herrings	
<u>Alosa sapidissima</u> (American shad)	A,I
<u>Clupea pallasii</u> (Pacific herring)	E,N
Family Engraulidae--anchovies	
<u>Engraulis mordax</u> (northern anchovy)	E,N
Family Osmeridae--smelts	
<u>Hypomesus pretiosus</u> (surf smelt)	E,N
Family Salmonidae--trouts	
<u>Oncorhynchus gorbuscha</u> (pink salmon)	A,N
<u>O. kisutch</u> (coho or silver salmon)	A,N
<u>O. tshawytscha</u> (chinook or king salmon)	A,N
<u>Salmo gairdnerii</u> (steelhead or rainbow trout)	A or R,N
<u>S. trutta</u> (brown trout)	R,I
Family Cyprinidae--minnows	
<u>Carassius auratus</u> (goldfish)	R,I
<u>Cyprinus carpio</u> (carp)	R,I
<u>Hesperoleucus symmetricus</u> (California roach)	R,N
<u>Lavinia exilicauda</u> (hitch)	?I,R
<u>Mylopharodon conocephalus</u> (hardhead)	R,N
<u>Orthodon microlepidotus</u> (Sacramento blackfish)	?I,R
<u>Ptychocheilus grandis</u> (Sacramento squawfish)	R,N
Family Catostomidae--suckers	
<u>Catostomus occidentalis</u> (Sacramento sucker)	R,N
Family Ictaluridae--catfishes	
<u>Ictalurus catus</u> (white catfish)	I,R
<u>I. melas</u> (black catfish)	?I,R
<u>I. nebulosus</u> (brown catfish)	I,R
<u>I. punctatus</u> (channel catfish)	I,R

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A = anadromous; I = introduced; E = estuarine; R = resident;  
N = native to Russian River

Table 1, continued

Family Poeciliidae--livebearers	
<u>Gambusia affinis</u> (mosquitofish)	I,R
Family Atherinidae--silversides	
<u>Atherinops affinis</u> (topsmelt)	E,N
Family Gasterosteidae--sticklebacks	
<u>Gasterosteus aculeatus</u> (threespine stickleback)	A,N
Family Syngnathidae--pipefishes	
<u>Syngnathus leptorhynchus</u> (bay pipefish)	E,N
Family Cottidae--sculpins	
<u>Cottus aleuticus</u> (Coastrange sculpin)	R,N
<u>C. asper</u> (prickly sculpin)	R,N
<u>C. gulosus</u> (riffle sculpin)	R,N
<u>Leptocottus armatus</u> (staghorn sculpin)	E,N
Family Serranidae--sea basses	
<u>Roccus saxatilis</u> (striped bass)	A,I
Family Centrarchidae--sunfishes	
<u>Archoplites interruptus</u> (Sacramento perch)	?I,R
<u>Lepomis cyanellus</u> (green sunfish)	I,R
<u>L. macrochirus</u> (bluegill)	I,R
<u>L. microlophus</u> (redeer sunfish)	I,R
<u>Micropterus dolomieu</u> (smallmouth bass)	I,R
<u>M. salmoides</u> (largemouth bass)	I,R
? <u>Pomoxis annularis</u> (white crappie)	I,R
<u>P. nigromaculatus</u> (black crappie)	I,R
Family Embiotocidae--surfperches	
<u>Cymatogaster aggregata</u> (shinerperch)	E,N
<u>Hysterocarpus traskii</u> <u>pomo</u> (Russian River tuleperch)	R,N
Family Grobiidae--gobies	
<u>Clevelandia ios</u> (arrow goby)	E,N
? <u>Acanthogobius flavimanus</u> (yellowfin goby)	I,E
? <u>Eucyclogobius newberryi</u> (tidewater goby)	E,N
Family Pleuronectidae--righteyed flounders	
<u>Platichthys stellatus</u> (starry flounder)	E,N

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Source: County of Sonoma, 1980 Technical Report on Fisheries  
of the Russian River

TABLE B-6

## ANADRAMOUS FISH OF SAN PABLO BAY

<u>Species</u>	<u>Migration and Spawning Seasons</u>	<u>Importance</u>
King or Chinook Salmon	Adults migrate through the bay to spawn in river tributaries. Three major migrations with the largest run in October-February when the water temperatures are below 14°C. Smolts <sup>1</sup> move downstream to Delta and Bay in the spring and summer months with some staying in the nursery areas till early winter.	Highly valued as both a commercial and recreational fishery. Commercial fishing is principally in the ocean since gill netting in the Bay was abolished in 1957. King salmon from the Sacramento-San Joaquin River system comprise 80% of the California ocean catch. King salmon is the most important commercial fishery in the San Francisco Bay Region with an estimated value of \$31.5 million to California's economy.
Striped Bass	Adults are found throughout the San Francisco Bay year round. Spawning migration into creeks occurs in spring when water temperatures range from 14.4°C-20°C. In wet years young-of-the-year migrate to the nursery areas downstream as far as San Pablo Bay but centered in Suisun Bay and the Delta. The juveniles migrate to the ocean and the Central Bay in the fall.	Striped bass was introduced into the S.F. Bay in 1879, and commercially fished till 1935. The recreational fishery is one of the most important in the S.F. Bay region with an estimated value of at least \$83 million.
Coho or Silver Salmon	Adults migrate upstream to spawn in the fall, spawn Nov.-Feb. and remain in the streams and nursery areas for one year before migrating to the ocean in May-July.	The San Pablo Bay is an important portion of the migration route for the San Joaquin and Sacramento River spawning run, the largest salmon run next to the Columbia River Run on the West Coast.

TABLE B-6 (continued)

<u>Species</u>	<u>Migration and Spawning Seasons</u>	<u>Importance</u>
Steelhead	Peak migrations in April-May and Sept. Spawn in upstream areas in Feb-June when water temperatures range from 12°-19°C.	The San Pablo Bay is an important nursery area for these fish.
Sturgeon (Green & White)	Occurs in the Bay year-round with populations centered in the San Pablo-Suisun Bay Area. Migrate upstream to spawn in the winter when water temp. range 10-24°C. Migrate downstream in the summer months.	Support a large recreational fishery with an estimated value of \$10.7 million. The commercial fishery for sturgeon was abolished in 1917.
American Shad	Migrate upstream to spawn in March-May. Spawn in Spring-Summer. Migrate downstream in Fall-Spring.	Introduced in 1871 and closed to commercial fishing in 1957. Most of the recreational fishery is confined to areas upstream of the Delta with an estimated value of \$3.2 million.

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<sup>1</sup>Smolts = Immature fish from the Fall run.

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**APPENDIX C**  
**FUNDAMENTAL CONCEPTS OF ENVIRONMENTAL NOISE**



## APPENDIX C

### FUNDAMENTAL CONCEPTS OF ENVIRONMENTAL NOISE

This section provides background information to aid in understanding the technical aspects of this report.

Three dimensions of environmental noise are important in determining subjective response. These are:

- a. the intensity or level of the sound
- b. the frequency spectrum of the sound
- c. the time-varying character of the sound

Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB), with 0 dB corresponding roughly to the threshold of hearing.

The "frequency" of a sound refers to the number of complete pressure fluctuations per second in the sound. The unit of measurement is the cycle per second (cps) or Hertz (Hz). Most of the sounds which we hear in the environment do not consist of a single frequency, but of a broad band of frequencies, differing in level. The quantitative expression of the frequency and level content of a sound is its sound spectrum. A sound spectrum for engineering purposes is typically described in terms of octave bands which separate the audible frequency range (for human beings, from about 20 to 20,000 Hz) into ten segments.

Many rating methods have been devised to permit comparisons of sounds having quite different spectra. Fortunately, the simplest method correlates with human response practically as well as the more complex methods. This method consists of evaluating all of the frequencies of a sound in accordance with a weighting that progressively and severely deemphasizes the importance of frequency components below 1000 Hz, with mild deemphasis above 5000 Hz. This type of frequency weighting reflects the fact that human hearing is less sensitive at low frequencies and extreme high frequencies than in the frequency midrange.

The weighting curve described above is called "A" weighting, and the level so measured is called the "A-weighted sound level," or simply "A-level."

The A-level in decibels is expressed "dBA"; the appended letter "A" is a reminder of the particular kind of weighting used for the measurement. In practice, the A-level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve. All U.S. and international standard sound level meters include such a filter. Typical A-levels measured in the environment and in industry are shown in Figure 1.

Although the A-level may adequately describe environmental noise at any instant in time, the fact is that the community noise level varies continuously. Most environmental noise includes a conglomeration of distant noise sources which create a relatively steady background noise in which no particular source is identifiable. These distant sources may

include traffic, wind in trees, industrial activities, etc. These noise sources are relatively constant from moment to moment, but vary slowly from hour to hour as natural forces change or as human activity follows its daily cycle. Superimposed on this slowly varying background is a succession of identifiable noisy events of brief duration. These may include nearby activities or single vehicle passages, aircraft flyovers, etc., which cause the environmental noise level to vary from instant to instant.

To describe the time-varying character of environmental noise, the statistical noise descriptors L10, L50, and L90 are commonly used. The L10 is the A-weighted sound level equaled or exceeded during 10 percent of a stated time period. The L10 is considered a good measure of the "average peak" noise. The L50 is the A-weighted sound level that is equaled or exceeded 50 percent of a stated time period. The L50 represents the median sound level. The L90 is the A-weighted sound level equaled or exceeded during 90 percent of a stated time period. The L90 is used to describe the background noise.

As it is often cumbersome to describe the noise environment with these statistical descriptors, a single number descriptor called the Leq is also widely used. The Leq is defined as the equivalent steady-state sound level which in a stated period of time would contain the same acoustic energy as the time-varying sound level during the same time period. The Leq is particularly useful in describing the subjective change in an environment where the source of noise remains the same but there is change in the level of activity. Widening roads and/or increasing traffic are examples of this kind of situation.

In determining the daily measure of environmental noise, it is important to account for the difference in response of people to daytime and nighttime noises. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most household noise also decreases at night and exterior noises become very noticeable. Further, most people are sleeping at night and are very sensitive to noise intrusion.

To account for human sensitivity to nighttime noise levels a descriptor, Ldn, (day-night equivalent sound level) was developed. The Ldn divides the 24-hour day into the daytime of 7 a.m. to 10 p.m. and the nighttime of 10 p.m. to 7 a.m. The nighttime noise level is weighted 10 dB higher than the daytime noise level. The Ldn, then, is the A-weighted average sound level in decibels during a 24-hour period with 10 dBA added to the hourly Leqs during the nighttime. For highway noise environments the Leq during the peak traffic hour is approximately equal to the Ldn.

The effects of noise on people can be listed in three general categories:

1. subjective effects of annoyance, nuisance, dissatisfaction
2. interference with activities such as speech, sleep, learning
3. physiological effects such as startle, hearing loss

The sound levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Unfortunately, there is as yet no completely satisfactory measure of the subject effects of noise, or of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance, and habituation to noise over differing individual past experiences with noise.

Thus, an important parameter in determining a person's subjective reaction to a new noise is the existing noise environment to which one has adapted: the so-called "ambient" noise. "Ambient" is defined as "the all-encompassing noise associated with a given environment, being a composite of sounds from many sources, near and far." In general, the more a new noise exceeds the previously existing ambient, the less acceptable the new noise will be judged by the hearers.

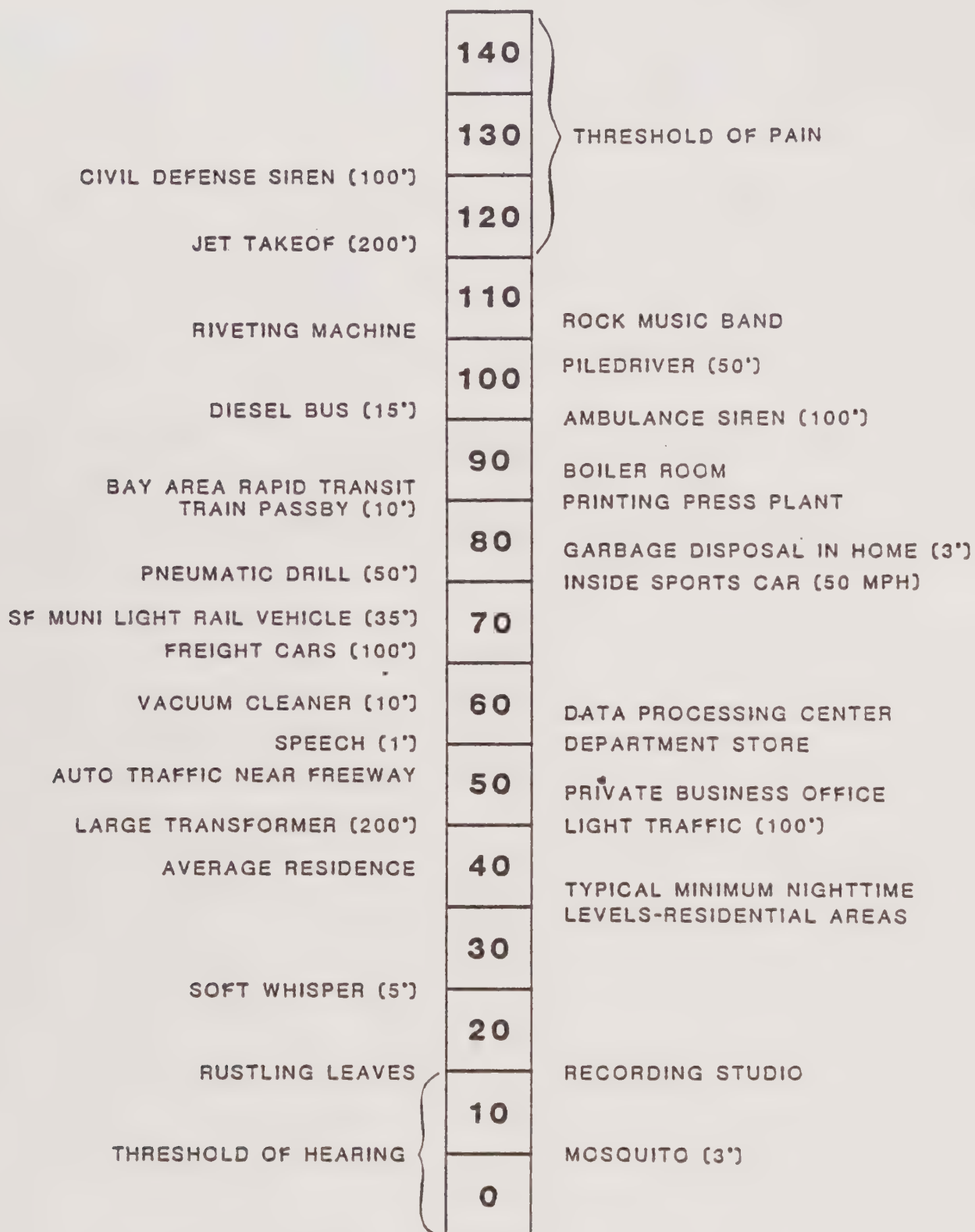
With regard to increases in noise level, knowledge of the following relationships will be helpful in understanding the quantitative sections of this report:

1. Except in carefully controlled laboratory experiments, a change of only 1 dBA cannot be perceived.
2. Outside of the laboratory, a 3-dBA change is considered a just-noticeable difference.
3. A change in level of at least 5 dBA is required before any noticeable change in community response would be expected.
4. A 10-dBA change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse change in community response.

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Source : Charles M. Salter Associates, Inc., December 1982.

# A-WEIGHTED SOUND PRESSURE LEVEL, IN DECIBELS



(100')-DISTANCE IN FEET BETWEEN SOURCE AND LISTENER

TYPICAL SOUND LEVELS  
MEASURED IN THE ENVIRONMENT AND INDUSTRY

**APPENDIX D**  
**AMBIENT AIR QUALITY STANDARDS**



## AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards <sup>1</sup>		National Standards <sup>2</sup>		
		Concentration <sup>3</sup>	Method <sup>4</sup>	Primary <sup>3, 5</sup>	Secondary <sup>3, 6</sup>	Method <sup>7</sup>
Oxidant <sup>10</sup>	1 hour	0.10 ppm (200 ug/m <sup>3</sup> )	Ultraviolet Photometry	—	—	—
Ozone	1 hour	—	—	0.12 ppm (235 ug/m <sup>3</sup> )	Same as Primary Standard	Ethylene Chemiluminescence
Carbon Monoxide	8 hour	9.0 ppm (10 mg/m <sup>3</sup> )	Non-Dispersive Infrared Spectroscopy (NDIR)	10 mg/m <sup>3</sup> (9 ppm)	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy (NDIR)
	1 hour	20 ppm (23 mg/m <sup>3</sup> )		40 mg/m <sup>3</sup> (35 ppm)		
Nitrogen Dioxide	Annual Average	—	Gas Phase Chemilumi- nescence	100 ug/m <sup>3</sup> (0.05 ppm)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 hour	0.25 ppm (470 ug/m <sup>3</sup> )		—		
Sulfur Dioxide	Annual Average	—	Ultraviolet Fluorescence	80 ug/m <sup>3</sup> (0.03 ppm)	—	Pararosaniline
	24 hour	0.05 ppm (131 ug/m <sup>3</sup> ) <sup>8</sup>		365 ug/m <sup>3</sup> (0.14 ppm)	—	
	3 hour	—		—	1300 ug/m <sup>3</sup> (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m <sup>3</sup> )		—	—	
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m <sup>3</sup>	High Volume Sampling	75 ug/m <sup>3</sup>	60 ug/m <sup>3</sup>	High Volume Sampling
	24 hour	100 ug/m <sup>3</sup>		260 ug/m <sup>3</sup>	150 ug/m <sup>3</sup>	
Sulfates	24 hour	25 ug/m <sup>3</sup>	Turbidimetric Barium Sulfate	—	—	—
Lead	30 day Average	1.5 ug/m <sup>3</sup>	Atomic Absorption	—	—	—
	Calendar Quarter	—	—	1.5 ug/m <sup>3</sup>	Same as Pri- mary Standard	Atomic Absorption
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m <sup>3</sup> )	Cadmium Hydrox- ide STRactan	—	—	—
Vinyl Chloride (Chloroethene)	24 hour	0.010 ppm (26 ug/m <sup>3</sup> )	Tedlar Bag Collection, Gas Chromatography	—	—	—
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility <sup>9</sup> to less than 10 miles when the relative humidity is less than 70%			—	—

### APPLICABLE ONLY IN THE LAKE TAHOE AIR BASIN:

Carbon Monoxide	8 hour	6 ppm (7 mg/m <sup>3</sup> )	NDIR	—	—	—
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility <sup>9</sup> to less than 30 miles when the relative humidity is less than 70%			—	—

## NOTES:

1. California standards, other than carbon monoxide, are values that are not to be equaled or exceeded. The carbon monoxide standards are not to be exceeded.
2. National standards, other than ozone and those based on annual averages or annual geometric means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days a calendar year with a maximum hourly average-concentration above the standard is equal to or less than one.
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
4. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.
7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
8. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.
9. At locations where the state standards for oxidant and/or suspended particulate matter are violated. National standards apply elsewhere.
10. Measured as ozone.

**APPENDIX E**  
**REPORT PREPARATION**



APPENDIX E  
REPORT PREPARATION

The Environmental Impact Report was prepared by EIP Associates under the direction of Mr. Wayne Goldberg, City of Santa Rosa, Director of Community Development. Assistance was provided by Mr. David Richardson, Project Manager and other staff members of CH2M-Hill, the City's consulting engineer. EIP staff contributors to the report include:

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